# FIELD DEMONSTRATION REPORT

on

# RECYCLING SPENT SANDBLASTING GRIT INTO ASPHALTIC CONCRETE

## VOLUME I

## FIELD DEMONSTRATION TEST METHODS, RESULTS, AND CONCLUSIONS

to

Naval Facilities Engineering Services Center
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by

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ABR | approximate bitumen ratio |
| ASTM | American Society for Testing and Materials |
| BAAQMD | Bay Area Air Quality Management District |
| Caltrans | California Department of Transportation |
| CAL WET | California Waste Extraction Test |
| CAM | California Assessment Manual |
| CARB | California Air Resources Board |
| CCR | California Code of Regulations |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CKE | centrifuge kerosene equivalent |
| DBT | dibutyltin |
| DTSC | (California) Department of Toxic Substances Control |
| EPA | Environmental Protection Agency |
| EP Tox | extraction procedure toxicity |
| GC | gas chromatography |
| GCAPCD | Glenn County Air Pollution Control Division |
| GC/MS | gas chromatography/mass spectrometry |
| HPA | Hunters Point Annex |
| HSC | Health and Safety Code |
| ICP | inductively coupled plasma |
| MBT | monobutyltin |
| MDL | method detection limit |
| MINIRAM | miniature real-time aerosol monitor |
| NOSC | Naval Ocean Systems Center |
| OSHA | Occupational Safety and Health Administration |
| PAHs | polyaromatic hydrocarbons |
| PCBs | polychlorinated biphenyls |
| PCF | pound per cubic foot |
| QC | quality control |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |

| | |
|---|---|
| SAE | Society of Automotive Engineers |
| STLC | (California) Soluble Threshold Limit Concentration |
| SVOC | semivolatile organic compound |
| TBT | tributyltin |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TLV | threshold limit value |
| TTLC | (California) Total Threshold Limit Concentration |
| TWA | time-weighted average |
| VOC | volatile organic compound |
| WESTDIV | Western Division |
| WET | Waste Extraction Test |

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# 1.0 INTRODUCTION

This field demonstration report describes a full-scale field demonstration of recycling spent sandblasting grit from Hunters Point Annex (HPA). The report discusses characterization and testing leading up to the demonstration, activities performed in the demonstration, results of the demonstration, applicability of the recycling process to other sites, and lessons learned during the project.

## 1.1 Purpose of the Project

The field demonstration was performed to collect data about a process to recycle spent silica sandblasting grit as part of the aggregate in forming asphaltic concrete. "Asphaltic concrete" is a mixture of a bituminous thermoplastic polymer used as cement with graded aggregate to form a flexible paving material. Asphaltic concrete is also called "bituminous paving" and in common terms is often shortened to "asphalt." The field demonstration program was structured to collect data on process operations, product performance, and costs for conducting grit recycling at a commercial scale. The data are used to determine the effectiveness, implementability, and cost of the recycling option in the field demonstration and evaluate the potential for application of recycling of grit and other similar wastes by using them as aggregate in asphaltic concrete.

The recycling option takes advantage of favorable physical characteristics of the grit to allow the spent grit to function as a component in asphaltic concrete. Recycling of the grit reduces reliance on disposal or treatment and disposal as waste management options.

## 1.2 Scope of Project

All project activities were conducted using a silica sand spent sandblasting grit. The total amount of spent sandblasting grit used in the full-scale field demonstration was 4,665 tons, as determined from actual truck load weights. The grit used in the demonstration program has been the subject of an ongoing investigation by the U.S. Navy and Battelle Memorial Institute for several years. The grit consisted of two piles deposited on the industrial landfill area of the shipyard. The larger pile was about 3,200 $yd^3$ of spent abrasive remaining from ship cleaning operations. A smaller 800 $yd^3$ pile was created as the result of a partially successful treatability test of a chemical stabilization process. The spent grit is not a Resource Conservation and Recovery Act (RCRA) hazardous waste but was hazardous waste in California due to Soluble Threshold Limit Concentration (STLC) leachability of lead and copper.

The field demonstration project was the culmination of a series of projects studying environmentally responsible methods to manage spent sandblasting grit. The full-scale demonstration was preceded by sampling and analysis, bench-scale treatability studies, a pilot-scale test, and an air emissions risk assessment. These earlier activities will be described to provide a basis for the more detailed discussion of the test methods and results in the full-scale demonstration. The sequence of major events accomplished by this series of projects is summarized in Table 1-1. Papers published as a result of the project work are included in Appendix A.

## 1.3 Organization of Report

The report provides a comprehensive background on the characterization, regulatory compliance activities, and preliminary testing to document the framework for the field demonstration. The information is presented in two volumes. Volume I describes the activities, results, and conclusions related to testing activities. Volume II is a technology transfer manual describing the lessons learned in the field demonstration in the form of a "how-to" manual for recycling spent sandblasting grit.

Volume I starts with a summary of contaminant concentration and matrix properties in Section 2.0. Regulatory compliance activities are described in Section 3.0. The methods and results of bench-scale treatability testing are described in Section 4.0. Section 5.0 discusses grit pretreatment, asphalt manufacture, and preparation of test strips for a long-term pilot-scale test. The results of the pilot-scale testing including air monitoring during excavation and screening of spent sandblasting grit, chemical and physical testing of samples taken from the test strips, compliance of leaching tests with regulatory criteria, and results of a test of grinding the test strip are given in Section 6.0. These summaries of prior testing activities are supplemented with extensive backup detail in appendices.

The activities involved in the field demonstration are then described. Section 7.0 discusses preparation of asphalt at a commercial asphalt plant for the full-scale field demonstration and the test methods used in the field demonstration. The results of the field demonstration are described in Section 8.0. The advantages and limitations, lessons learned, and potential for technology transfer to other sites are briefly summarized in Section 9.0. The references are listed in Section 10.0.

Volume II provides a step-by-step guide to planning and performing a program to recycle spent sandblasting grit. This technology transfer volume discusses characterization of spent grit (Section 2.0), regulatory considerations (Section 3.0), asphalt mix design (Section 4.0), work plan development and contracting procedures (Sections 5.0 and 6.0), typical costs for grit recycling (Section 7.0), the advantages and disadvantages of recycling spent grit as asphalt aggregate (Section 8.0), and the references used to prepare Volume II (Section 9.0).

## Table 1-1. Summary of Major Project Events

| Date | Activity | Comments |
|---|---|---|
| 11/88 | Performed sampling of spent grit pile as part of sulfide stabilization test | Provided characterization data for untreated grit |
| 11/89 | Field test of sulfide stabilization | Unable to completely reduce California Waste Extraction Test (CAL WET) leaching of Pb and Cu to regulatory levels.<br><br>Resulted in 3,200 $yd^3$ untreated pile and 800 $yd^3$ sulfide-treated grit pile |
| 1/91 | Initial asphalt treatability test | Tested 46% and 7% grit mixtures and determined 7% grit could reliably pass CAL WET test |
| 11/91 | Placed pilot-scale asphalt test strips and collected first core samples | Samples taken indicated good leach resistance and physical properties |
| 6/93 | Collected second core samples from pilot-scale test strips | Samples taken indicated good leach resistance and physical properties |
| 7/93 | Road surface milling test with pilot-scale strips | Measured low lead and copper levels in air emissions during scarification to simulate road surface renewal process |
| 2/94 | Identified Jaxon, Inc., Orland, CA hot-mix asphalt plant as site for full-scale test | |
| | Treatability test using Jaxon's bitumen | Tested 5% grit mixture and passed CAL WET |
| 6/94 | Collected third core samples from pilot-scale test strips | Samples taken indicated good leach resistance and physical properties |
| | Full-scale screening of grit and debris crushing | Material preparation for full-scale test |
| | Start of full-scale asphalt production/grit recycling demo | Samples taken indicated good leach resistance and physical properties |
| 10/95 | Completion of full-scale asphalt production/grit recycling demo | Samples taken indicated good leach resistance and physical properties |

# 2.0 INITIAL CHARACTERIZATION

This section describes the characterization of the spent sandblasting grit performed in preparation for the testing of recycling the grit as asphalt aggregate.

## 2.1 Site Description

From 1976 to 1986, the U.S. Navy leased most of its naval station, Treasure Island, Hunters Point Annex (HPA), to Triple A Machine Shop, which operated it as a commercial ship repair facility (see Figure 2-1). Triple A's shipyard corrosion control operations generated waste sandblasting grit, which was deposited in the industrial landfill area of the shipyard. An approximately 4,000-$yd^3$ pile of waste sandblasting grit present at the facility is the main source of material for the treatability studies, pilot-scale testing, and full-scale demonstration discussed in this Field Demonstration Report. A portion of the initial pile was used for a test of a chemical stabilization treatment of the spent grit. The treatment test occurred in December 1989 and consisted of treating about 800 $yd^3$ of spent grit with small additions of fly ash, sodium hydrosulfide, and water. The treatment did not completely stabilize the leachable lead and copper resulting in two spent grit types: (1) a larger pile of untreated grit and (2) a smaller pile of sulfide-treated grit. Thus, the main source for test material from HPA consists of two piles, an approximately 3,200 $yd^3$ pile of untreated grit and an approximately 800 $yd^3$ pile of grit that was treated using the chemical stabilization procedure with small amounts of fly ash, sodium hydrosulfide, and water in December 1989. The 3,200 $yd^3$ pile of grit has not been treated and is henceforth referred to as "untreated grit" (see Photo 2-1). The 800 $yd^3$ pile of sulfide-treated grit is henceforth referred to as "sulfide-treated grit." This terminology is used to distinguish the grit sources used for the recycling tests from the "asphalt-treated grit," which is the term that will be used in this work plan for the asphaltic concrete prepared using HPA grit as a portion of the aggregate.

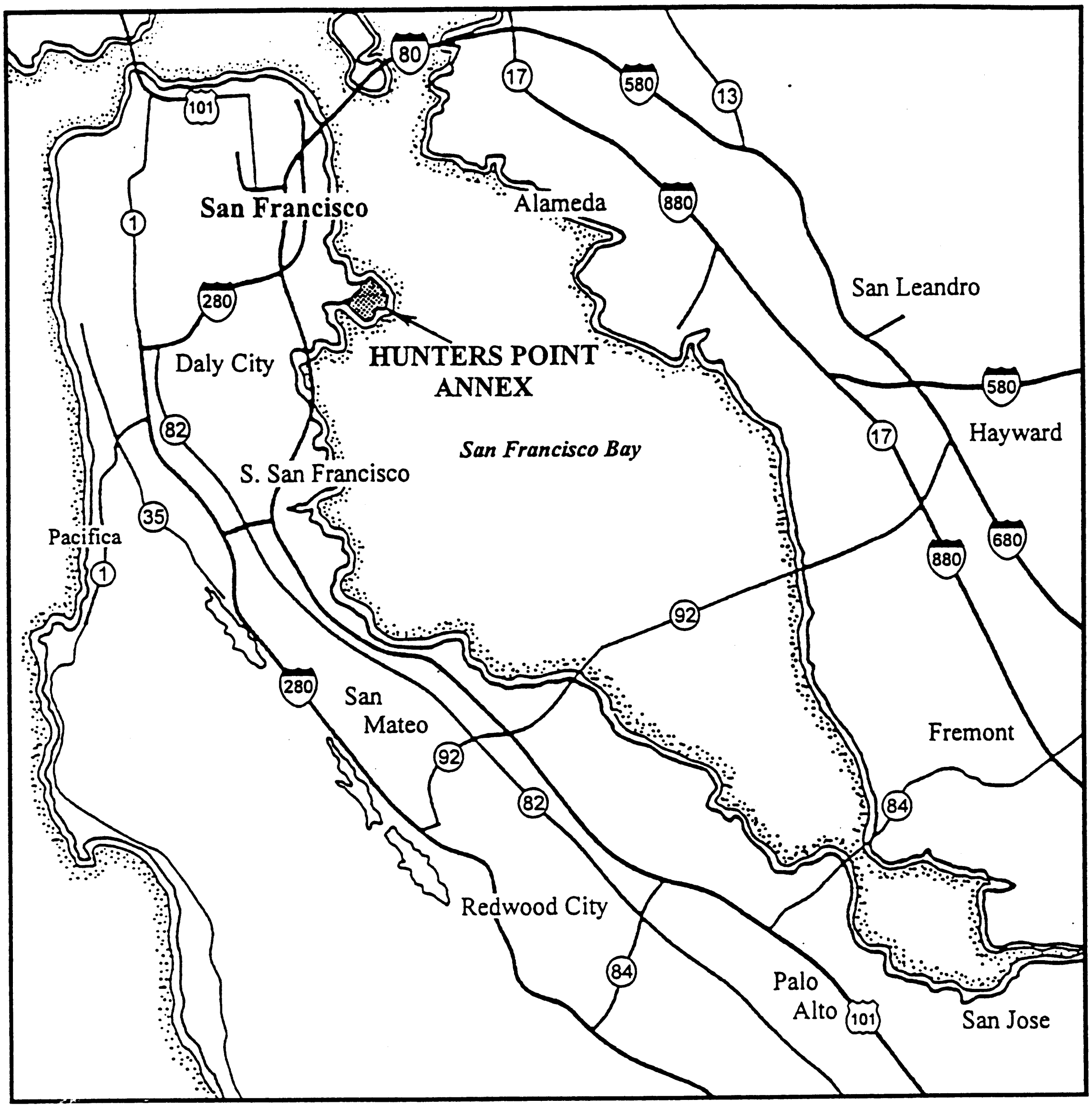
In addition, about 245 tons of grit were collected from eight small piles located around HPA. The site number, approximate amount of grit, and site description are shown in Table 2-1. The grit at Building PA44 was sampled on June 28, 1993. The other locations were sampled on March 15, 1994. All of the piles were collected by vacuum truck and screened during the full-scale field demonstration in June 1994.

## 2.2 Sampling and Analysis

Both the initial grit and the sulfide-treated grit have been extensively characterized chemically, based on statistically designed sampling and analysis methodology, as described in Means et al. (1991a, b). The types of analyses that were performed include the following:

- Total metals content (acid-digestible metals content for comparison with California Title 22 TTLC (Total Threshold Limit Concentration) for the 17 CAM (California Assessment Manual) metals plus hexavalent chromium.

- California WET (Waste Extraction Test) soluble metal content for metals having the potential of exceeding their Title 22 STLC (Soluble Threshold Limit Concentration) values based on the TTLC data.

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**Location of Hunters Point Annex in the San Francisco Bay Area**

| | | |
|---|---|---|
| DESIGNED BY J.M. | | |
| DRAWN BY V.S. | PROJECT HUNTERS POINT PROJECT | |
| CHECKED BY L.S. | PROJECT NUMBER G283201-FRIA | DATE 11/95 |

**Figure 2-1. Location of Hunters Point Annex**

**Photo 2-1. General area view of untreated grit pile.**

- Extraction procedure toxicity (EP Tox) and Toxicity Characteristic Leaching Procedure (TCLP) leaching data for the 8 RCRA metals.
- Organic priority pollutant data on both the untreated grit and the sulfide-treated grit.

**Table 2-1. Site Information for Additional Sandblasting Grit Wastes**

| Site # | Estimated Amount of Grit (tons) | Site Description |
|---|---|---|
| 1 | 20 | At PA26, west of Building 140 |
| 2 | 30 | At PA31 |
| 3 | 2 | Northeast of IR20 |
| 4A | 100 | At PA57, Hopper at drydock 4 |
| 4B | 1 | At PA57, south side of drydock 4 |
| 14 | 90 | At PA44 |
| 17A | 1 | At IR14/15, green diamond-type grit |
| 17B | 1 | IR14/15, beach sand-type grit |

- Organo-tin analyses to test for the presence of butyltin antifouling compounds in the grit.

The analytical methods used are summarized in Table 2-2.

In addition, one sample was taken from each of seven of the eight small piles and analyzed for TTLC and STLC metals. Five samples were taken from the grit pile at PA44 and analyzed for TTLC, STLC, and TCLP metals and total fluoride. The results of the analyses of untreated and sulfide-treated samples are presented in detail in Means et al. (1991a, b). Compositional summaries for metal and organic contaminants are presented in Section 2.3. The result of a grain-size analysis to determine matrix suitability as asphalt aggregate is provided in Section 2.4.

### 2.2.1 Sampling and Analysis for Metals Characterization

In 1988, the original 4,000 $yd^3$ pile of untreated grit was the subject of an extensive characterization effort. The results from this initial characterization provide the most detailed evaluation of variations in grit properties and used methods similar to those used in later characterization efforts. Therefore, sampling and characterization of the initial pile for total leachable metals will be described in detail to indicate the sampling and analysis methods used throughout the project.

The initial pile consisted of an accumulated pile of sandblasting grit situated on a cleared soil area. The pile is approximately 18 m (20 yd) wide by 41 m (45 yd) long, in the approximate shape of a kidney bean, and is about 3 m (9 ft) high with a relatively flat top. The pile has been covered with a tarpaulin to reduce dust emissions and the infiltration of precipitation through the pile.

Because of possible variations in metal concentrations in different parts of the pile, samples were collected from random locations on the surface and at various depths. In November 1988 the pile was gridded into equal surface areas by marking a coordinate every 2 m (6 ft). This resulted in 208 grids having surface areas of approximately 4 $m^2$ (36 $ft^2$) each (see Figure 2-2). The grid areas were numbered consecutively so that sample locations could be referenced. Then sample grid numbers were selected from a random number table for each sampling location. Twenty-four different samples were collected along with two blind replicates. Eight locations were sampled at each of three depth intervals: (a) 0 to 1 m (0 to 3 ft, avoiding the top 8 cm or 3 in.); (b) 1 to 2 m (3 to 6 ft); and (c) 2 to 3 m (6 to 9 ft).

The sulfide-treated grit pile was located just east of the untreated pile, stored on a plastic ground liner, and covered with plastic to protect it against the weather. The pile was approximately 25 yards long by 15 yards wide and 2 to 4 feet deep. The sulfide-treated pile contained sandblasting grit that was treated with aqueous sodium hydrosulfide, fly ash, and water.

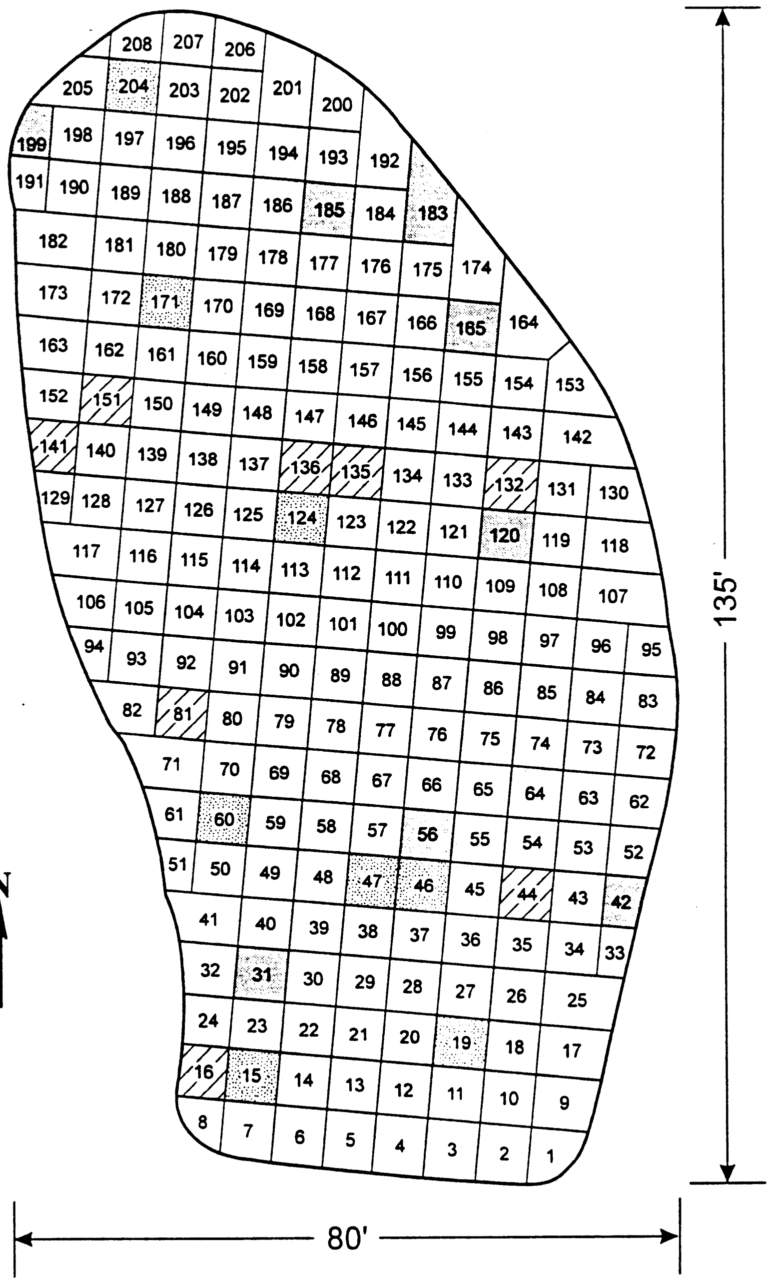
Samples were collected at varying depths and horizontal locations in the sulfide-treated pile. The sampling design for the treated material was a random grid design at two depths. Information on the variability of sample composition is necessary to ensure that the sampling reflects the actual composition of the entire 800 $yd^3$ of treated grit as closely as possible. Sixteen treated grit samples were collected.

Samples were collected using a stainless steel shovel for surface samples or a sand auger for depth samples (see Photo 2-2). A portion of each sample was archived for possible future use. Samples were split in the field using a riffle-type splitter, placed in precleaned polyethylene (I-Chem

Table 2-2. Methods Used for Chemical Analyses of Spent Sandblasting Grit

| | |
|---|---|
| **Extraction Methods** | |
| TTLC – California Title 22 CCR 66699 | |
| STLC – California Title 22 CCR 66699 | |
| TCLP – EPA SW-846 Method 1311 | |
| **Analytical Methods for Metals** | |
| Antimony | EPA SW-846 Method 7041 |
| Arsenic | EPA SW-846 Method 7060 |
| Barium | EPA SW-846 Method 7080 |
| Beryllium | EPA SW-846 Method 7090 |
| Cadmium | EPA SW-846 Method 7130 |
| Chromium | EPA SW-846 Method 7190 |
| Cobalt | EPA SW-846 Method 7200 |
| Copper | EPA SW-846 Method 7210/6010 |
| Lead | EPA SW-846 Method 7420/6010 |
| Mercury | EPA SW-846 Method 7471 |
| Molybdenum | EPA SW-846 Method 7480 |
| Nickel | EPA SW-846 Method 7520 |
| Selenium | EPA SW-846 Method 7740 |
| Silver | EPA SW-846 Method 7760 |
| Thallium | EPA SW-846 Method 7840 |
| Vanadium | EPA SW-846 Method 7910 |
| Zinc | EPA SW-846 Method 7950 |
| Hexavalent chromium | EPA SW-846 Method 7196 |
| **Analytical Methods for Organics** | |
| Volatile organics | EPA SW-846 Method 8240 |
| Semivolatile organics | EPA SW-846 Method 3510/8270 |
| Pesticides and polychlorinated biphenyls (PCBs) | EPA SW-846 Method 3510/8080 |
| Butyltin | Naval Ocean Systems Center Method |

Corp.) bottles, and immediately shipped under chain of custody to the appropriate laboratory for analysis or storage. The splitter, sampling devices, and mixing tray were cleaned between each sample. A field quality control (QC) blank was collected using clean sand to verify that cross-contamination was not occurring. Permanent field notebooks were maintained with proper documentation.




Surface Samples

Mid-Level Samples

Lower-Level Samples

*NOT TO SCALE*

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**Sampling Locations at the Waste Pile**

| | |
|---|---|
| DESIGNED BY J.M. | |
| DRAWN BY V.S. | PROJECT: HUNTERS POINT PROJECT |
| CHECKED BY L.S. | PROJECT NUMBER: G283201-FRIA; DATE: 11/95 |

**Figure 2-2. General Area View and Sampling Locations of Untreated Grit Pile**

Grit samples were submitted for chemical and physical testing. A summary of the chemical analyses used is provided in Table 2-2. The regulatory limits for the TTLC, STLC, and TCLP are summarized in Table 2-3 to serve as a basis for establishing regulatory requirements for waste management.

### 2.2.2 Sampling and Analysis for Organic Characterization

One sample each of untreated and sulfide-treated grit was collected at random from the appropriate grit piles for organic analysis. Because both the treated and untreated grit piles are covered with a heavy, sealed plastic tarpaulin, samples for volatile organics analysis were collected at the same time that the tarpaulin was cut to remove material for the demonstration. Once the material for the field demonstration had been removed from the piles, samples for volatile organics analysis were collected using a stainless steel auger and were then transferred immediately from the auger into a glass sample container by means of a stainless steel spoon. Any headspace or air voids were eliminated while filling the sample container. The sample from the untreated pile was collected from the southeast end of the pile, at a depth of approximately 2.5 feet; the sample from the treated pile was taken from the northwest corner of the pile, at a depth of approximately 1 foot. All sample bottles were placed in polyethylene bags and then securely sealed after label information and sample identification were checked and entered on standard chain-of-custody forms. The samples were immediately shipped to a California-certified analytical laboratory, which performed the analyses with U.S. EPA holding times. Grit samples were analyzed for volatile organic priority pollutants using EPA Method 8240 (see Table 2-2).

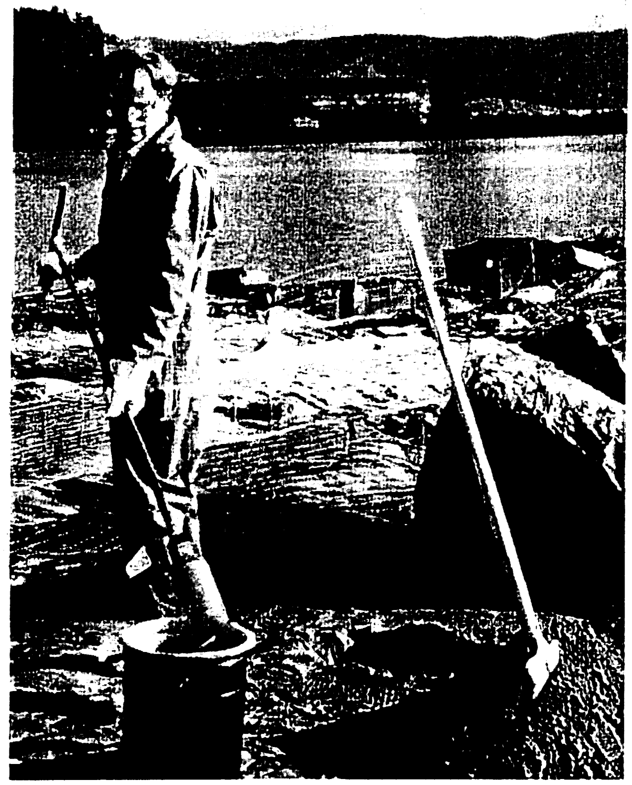


**Photo 2-2. Using a sand auger to sample the spent sandblasting grit pile at Hunters Point Annex.**

### 2.2.3 Sampling and Analysis for Debris Characterization

The untreated pile of spent sandblasting grit contains wood, cloth, and metal debris. These debris are not compatible with use as asphalt aggregate and thus would be separated and disposed of by a different waste management method. Analysis of total metals, WET leachable metals, and TCLP leachable metals in the debris is needed to determine the appropriate management method.

Composite grab samples of debris were collected from the edges of the untreated pile on two occasions. Three samples of wood, cloth, and metal were collected during the first sampling event (October 24, 1991) and three samples of cloth and four of wood were collected during the second sampling event (June 28, 1993). The samples were placed in cleaned sample bottles. The bottles

Table 2-3. **Total and Soluble Metal Concentration Regulatory Thresholds**

| Element | TTLC[(a)] (mg/kg) | STLC[(a)] (mg/L) | TCLP[(b)] (mg/L) |
|---|---|---|---|
| Cu | 2,500 | 25 | – |
| Pb | 1,000 | 5 | 5 |
| Sb | 500 | 15 | – |
| As | 500 | 5 | 5 |
| Ba | 10,000 | 100 | 100 |
| Be | 75 | 0.75 | – |
| Cd | 100 | 1 | 1 |
| Cr (Total) | 2,500 | 560 | 5 |
| Cr(VI) | 500 | 5 | – |
| Co | 8,000 | 80 | – |
| Hg | 20 | 0.2 | 0.2 |
| Mo | 3,500 | 350 | – |
| Ni | 2,000 | 20 | – |
| Se | 100 | 1 | 1 |
| Ag | 500 | 5 | 5 |
| Tl | 700 | 7 | – |
| V | 2,400 | 24 | – |
| Zn | 5,000 | 250 | – |

(a) From California Code of Regulations, Title 22, Section 66699
TTLC = Total Threshold Limit Concentration
STLC = Soluble Threshold Limit Concentration using the California Waste Extraction Test (CAL WET)
(b) Toxicity Characteristic Leaching Procedure (TCLP)
*Federal Register, 55*(61):11804, Thursday, March 29, 1990.
Source: Means et al. (1991a).

were then labeled, placed in polyethylene bags, and shipped (with standard chain-of-custody forms) to the laboratory.

### 2.2.4 Sampling Minor Grit Accumulations

Samples were collected from eight small piles of spent sandblasting grit at various locations abound HPA (see Section 2.1). In all cases, the samples were collected as composite grab samples using a stainless steel shovel.

## 2.3 Contaminant Concentration and Leachability

This section describes the results of analyses of the total concentration and leachability of contaminants in the spent sandblasting grit.

### 2.3.1 Metal Composition Data

A summary of total metals concentration data is provided in Table 2-4 for both the untreated and sulfide-treated grits. Copper, lead, and zinc are the primary metal contaminants. Traces of

**Table 2-4. Mean Metal Contents (TTLC Analysis) for Untreated and Sulfide-Treated Grit Samples**

| Element | Total Metal Concentration (mg/kg) | | |
|---|---|---|---|
| | Untreated Grit | Sulfide-Treated Grit | TTLC Limit[a] |
| Cu | 1,832 | 1,300 | 2,500 |
| Pb | 204 | 160 | 1,000 |
| Sb | 11 | <20 | 500 |
| As | 5.4 | 1.5 | 500 |
| Ba | 246 | 160 | 10,000 |
| Be | 0.2 | <0.6 | 75 |
| Cd | <0.5 | <1 | 100 |
| Cr (Total) | 99.8 | 34 | 2,500 |
| Cr(VI) | 11.2 | <1 | 500 |
| Co | 8.2 | 9 | 8,000 |
| Hg | <0.4 | <0.1 | 20 |
| Mo | 11.6 | <10 | 3,500 |
| Ni | 79 | 54 | 2,000 |
| Se | <0.5 | <0.1 | 100 |
| Ag | 1.3 | <1.0 | 500 |
| Tl | 5.0 | <6.0 | 700 |
| V | 22.1 | <21.3 | 2,400 |
| Zn | 1,062 | 960 | 5,000 |

(a) From California Code of Regulations, Title 22, Section 66699.
TTLC = Total Threshold Limit Concentration.
Source: Means et al., 1993a, Table 1-1.

several other metals are also present. Comparison with the TTLC criteria in the right-hand column of Table 2-4 shows that the HPA grit is *not* TTLC-hazardous.

A similar summary of the CAL WET-soluble metals concentration data is provided in Table 2-5, again for both the untreated and sulfide-treated grits. Copper and lead exceed their

**Table 2-5. Mean WET-Soluble Metal Contents (STLC Analysis) for Untreated and Sulfide-Treated Grit Samples[a]**

| Element | Soluble Metal Concentration (mg/L) | | |
|---|---|---|---|
| | Untreated Grit | Sulfide-Treated Grit | STLC Limit[b] |
| Cu | **144** | **55.5** | 25 |
| Pb | **19** | **11.1** | 5 |
| Sb | NA | <1.0 | 15 |
| As | 0.06 | 0.11 | 5 |
| Ba | 6.8 | 2.3 | 100 |
| Be | <0.03 | <0.03 | 0.75 |
| Cd | <0.06 | <0.05 | 1 |
| Cr (Total) | 2.0 | 1.4 | 560 |
| Cr(VI) | <1.0 | <1.0 | 5 |
| Co | <0.2 | <0.2 | 80 |
| Hg | <0.01 | <0.01 | 0.2 |
| Mo | <1.0 | <1.0 | 350 |
| Ni | 1.0 | 1.2 | 20 |
| Se | <0.01 | <0.01 | 1 |
| Ag | <0.05 | <0.05 | 5 |
| Tl | <0.3 | <0.3 | 7 |
| V | <1.0 | <1.0 | 24 |
| Zn | 146 | 89 | 250 |

(a) Samples exceeding STLC are shown in bold type.
(b) From California Code of Regulations, Title 22, Section 66699.
STLC = Soluble Threshold Limit Concentration
NA = Not analyzed.
Source: Means et al., 1993a, Table 1-2.

respective STLCs for both the untreated and sulfide-treated grit. Therefore, the grits are considered hazardous in California. The STLC Cu and Pb contents of the sulfide-treated grit were significantly lower than the STLC Cu and Pb contents of the untreated grit (Means, 1991a, b).

Table 2-6 summarizes the TCLP and EP Tox data for the untreated and sulfide-treated grit. None of the metals exceed their TCLP thresholds; therefore, the waste is not a RCRA hazardous waste. It is only considered hazardous by virtue of STLC Cu and Pb exceedances and is referred to as a California-only hazardous waste.

Examination of the total metal composition variation among samples of untreated grit indicates the potential range of contaminant composition that the asphalt recycling process will need to accommodate. Data for the mean and 80% upper confidence limit are shown in Table 2-7. Source data showing results for all samples are compiled in Appendix B. For all metals, the 80% upper confidence limit is close to the mean, indicating that the metal contaminants are uniformly distributed. Comparison of copper and lead composition as a function of depth, as shown in Table 2-8 also shows no tendency for wide compositional variation at various depths.

Results for leachable lead and copper as measured by the CAL WET procedure indicate stratification. As shown in Figure 2-3, both copper and lead appear to be more leachable in surface samples (3-inch to 1-foot depth) than in the samples taken from the 1 foot to 2.5 foot depth interval. Although the pile has been covered, weathering may have changed the chemical or physical form of the metal contaminants, causing the surface samples to be less leach resistant.

**Table 2-6. Mean TCLP- and EP Tox Soluble Metal Contents for Untreated and Sulfide-Treated Grit Samples**

| Element | Soluble Metal Concentration (mg/L) | | |
|---|---|---|---|
| | Untreated Grit | Sulfide-Treated Grit | TCLP Limit[a] |
| Pb | 1.11[a] | <0.5 | 5 |
| As | <0.5 | <0.5 | 5 |
| Ba | <5 | <5 | 100 |
| Cd | <0.05 | 0.1 | 1 |
| Cr | <0.5 | <0.5 | 5 |
| Hg | <0.02 | <0.02 | 0.2 |
| Se | <0.05 | <0.05 | 1 |
| Ag | <0.05 | <0.5 | 5 |

(a) EP Tox value is 0.6 mg/L vs. an EP Tox limit of 5 mg/L.
Source: Means et al., 1993a, Table 1-3.

Grit accumulations from various locations on base that were collected using a vacuum truck (see Photos 2-3 through 2-5) and consolidated into a single pile for asphalt recycling were chemically analyzed for total and WET-soluble CAM metals (18 different analyses). Collection and consolidation occurred during the full-scale field demonstration in June 1994 (see Section 7.2). Grit at Building PA44 was sampled on June 28, 1993. Grit at the other locations was sampled on March 15, 1994. The averages of the results for the TTLC, STLC, and TCLP from 5 samples taken from the grit pile at Building PA44 are compared to the results for untreated grit in Tables 2-9, 2-10, and 2-11, respectively. Results for TTLC and STLC metals for the other seven sites are shown in Tables 2-12 and 2-13, respectively. In general the metals concentrations are consistent with the data collected by personnel from PRC, Inc. previously on this grit, i.e., metal concentrations are relatively low and compatible with the asphalt recycling option. The composite grit sample is coded

Table 2-7. Statistical Summary of Metal Analysis for Untreated Samples

| Element | Total Concentration, mg/kg | | |
|---|---|---|---|
| | Mean | Upper 80% Confidence Limit | TTLC Limit[(a)] |
| Cu | 1,832 | 1,926 | 2,500 |
| Pb | 204 | 219 | 1,000 |
| Sb | 11 | –[(b)] | 500 |
| As | 5.4 | 6.0 | 500 |
| Ba | 246 | 277 | 10,000 |
| Be | 0.2 | 0.23 | 75 |
| Cd | <0.5 | –[(c)] | 100 |
| Cr (Total) | 99.8 | 115.5 | 2,500 |
| Cr(VI) | 11.2 | –[(d)] | 500 |
| Co | 8.2 | 9.9 | 8,000 |
| Hg | <0.4 | –[(c)] | 20 |
| Mo | 11.6 | 17.6 | 3,500 |
| Ni | 79 | 103 | 2,000 |
| Se | <0.5 | –[(c)] | 100 |
| Ag | 1.3 | –[(e)] | 500 |
| Tl | 5.0 | 5.0[(c)] | 700 |
| V | 22.1 | 25.4 | 2,400 |
| Zn | 1,062 | 1,330 | 5,000 |

(a) From California Administrative Code, Title 22, Section 66699.
TTLC = Total Threshold Limit Concentration
(b) One data point.
(c) All samples have concentrations below the detection limit.
(d) Only two data points.
(e) Only one data point above the detection limit.

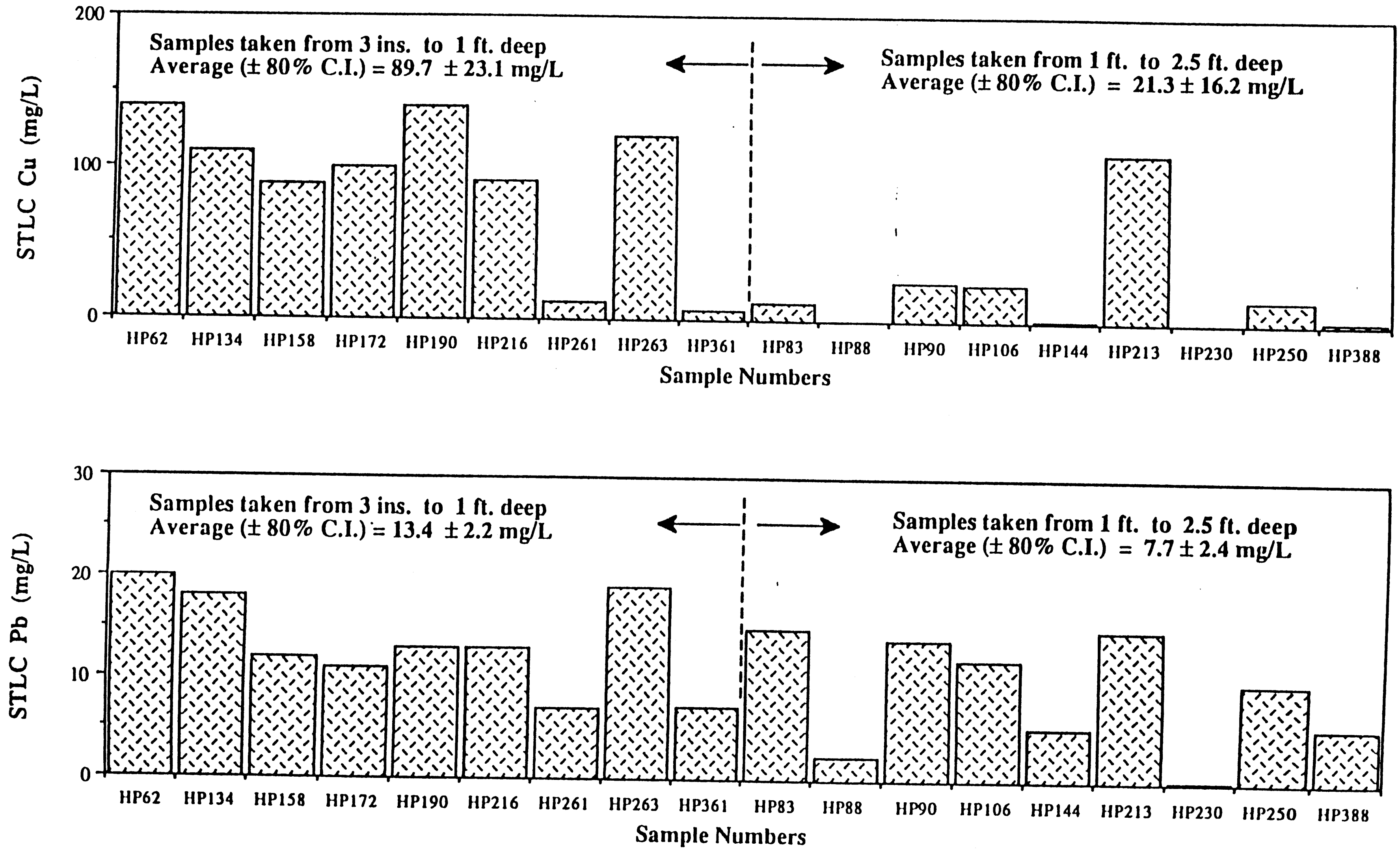
"VAC-CS-1" and is not a hazardous waste because it passes both the TTLC and STLC criteria, as shown in Tables 2-12 and 2-13.

### 2.3.2 Organic Contaminant Composition Data

With the exception of organometallic antifouling compounds, organic contaminants typically would not be associated with sandblasting wastes. However, the contaminants being cleaned from the ship surface might have included organics, or organics might have been added inadvertently to or spilled near the waste pile. Analyses for a wide range of organic contaminants, including volatile

Table 2-8. Cu and Pb Concentrations Versus Depth

| Layers (ft) | No. of Samples | Total Cu (mg/kg) | | | Total Pb (mg/kg) | | |
|---|---|---|---|---|---|---|---|
| | | Mean Concentration Cu | Standard Deviation Cu | 80% Upper Confidence Level Cu | Mean Concentration Pb | Standard Deviation Pb | 80% Upper Confidence Level Pb |
| 0-3 | 9 | 1,729 | 512 | 1,954 | 194 | 54.8 | 218 |
| 3-6 | 9 | 1,960 | 324 | 2,103 | 232 | 73.3 | 264 |
| 6-9 | 8 | 1,800 | 207 | 1,904 | 185 | 48.3 | 206 |




Source: Means et al., 1991a.

**Figure 2-3. Graphical Representation of STLC Data From Treated Grit Pile as a Function of Sample Depth.**

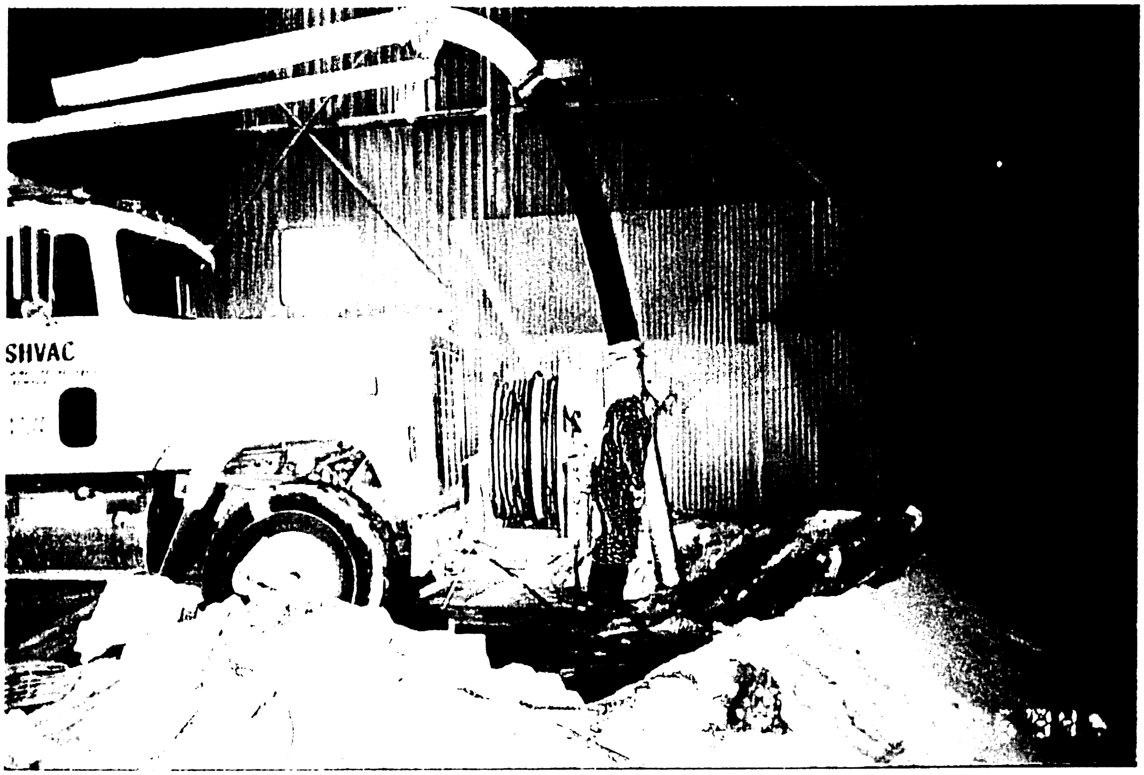



**Photo 2-3. Collecting grit from inside Building PA44 with a vacuum truck.**

**Photo 2-4. Collecting grit outside Building PA44.**

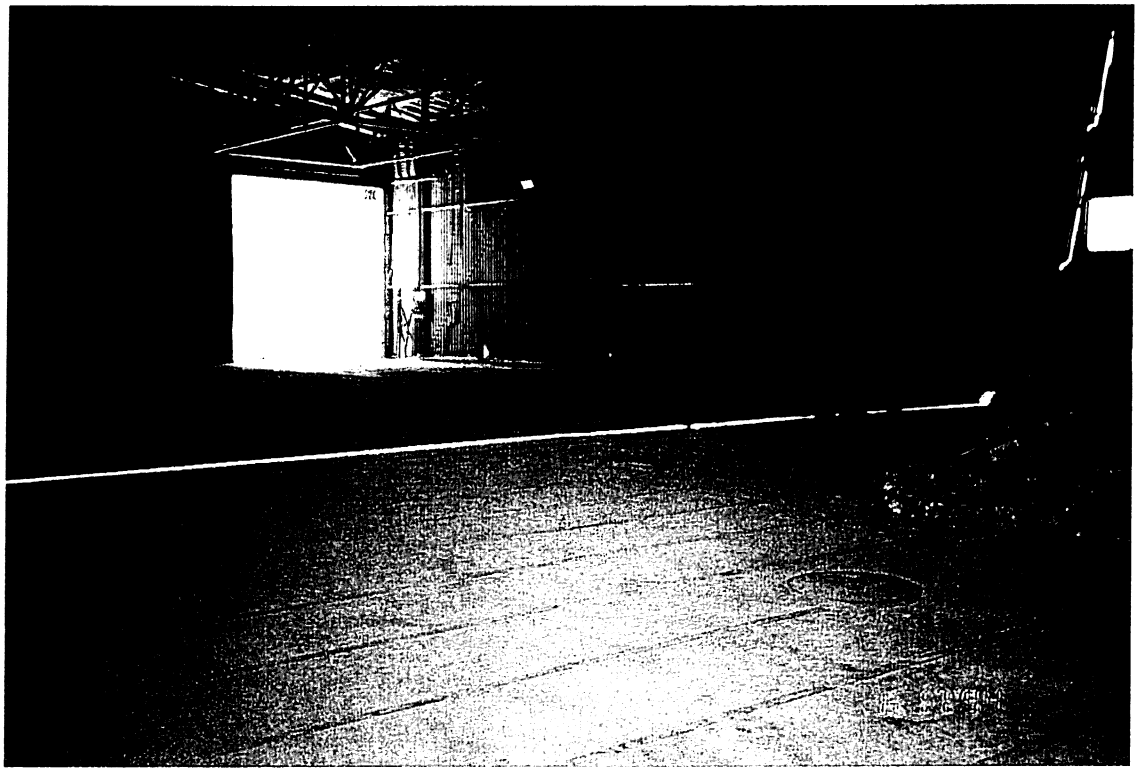


**Photo 2-5. Interior view of Building PA44 after removal of the grit.**

organic compounds (VOCs), semivolatile organic compounds (SVOCs), and pesticides and polychlorinated biphenyls (PCBs), were completed to establish a complete picture of a contaminant concentrations in the spent sandblasting grit. Results from the volatile organic contaminant analysis for untreated and treated grit are shown in Tables 2-14 and 2-15, respectively.

Several organic compounds were detected in low part-per-million concentrations, including traces of several PAHs (polyaromatic hydrocarbons), phthalates, PCBs, and volatile solvent-type compounds. However, the volatile organics analyses are suspect because the laboratory blank also contained trace levels of similar compounds (Means et al., 1991a).

The butyltin data included mono-, di-, and tributyltin compounds, which are frequently applied to ship hulls as antifouling compounds. The priority pollutant analyses are documented in Means et al. (1991b) and the butyltin analyses were completed by Naval Ocean Systems Center (NOSC). The results of the butyltin analysis on untreated spent grit are summarized in Table 2-16. The effects of heating and asphalt treatment on butyltin compounds are discussed in the treatability test section (Section 4.3).

### 2.3.3 Debris Contaminants

The first set of three samples of wood, cloth, and metal debris was taken on October 24, 1991 and was analyzed for WET-soluble and total Cu and Pb by a California-certified analytical laboratory. The results are shown in Table 2-17. The wood and the cloth appear to be California-hazardous, the wood based on STLC Pb exceedances in two of the three samples analyzed and the cloth based on STLC Cu and Pb and TTLC Cu exceedances. The average data on the steel debris indicated a

**Table 2-9. Mean TTLC Metal Contents of the Grit from Building PA44 Compared to the Untreated Grit in Pile**

| Element | Total Metal Concentration (mg/kg) | |
|---|---|---|
| | PA44 Grit (average of 5 samples) | Untreated Grit |
| Cu | 205 | 1,832 |
| Pb | 78 | 204 |
| Sb | 9.6 | 11 |
| As | 2.6 | 5.4 |
| Ba | 60.2 | 246 |
| Be | <1.0 | 0.2 |
| Cd | 2.6 | <0.5 |
| Cr (Total) | 142 | 99.8 |
| Cr(VI) | 0.01 | 11.2 |
| Co | 7.7 | 8.2 |
| Hg | 0.06 | <0.4 |
| Mo | 7.1 | 11.6 |
| Ni | 285 | 79 |
| Se | <0.5 | <0.5 |
| Ag | 2.4 | 1.3 |
| Tl | <20 | 5.0 |
| V | 12.2 | 22.1 |
| Zn | 392 | 1,062 |
| F | 2.9 | NA |

Source: Means et al., 1993b, Table 1-1.

nonhazardous classification. However, one sample showed a very slight TTLC Pb exceedance and another sample exhibited a very slight STLC Pb exceedance (Means et al., 1993a).

A second set of cloth and wood grab samples was collected on June 28, 1993 and analyzed to confirm the status of debris as hazardous waste (Means et al., 1993b).

Three grab samples of cloth debris from the untreated grit pile were analyzed for TCLP Pb. The results are presented in Table 2-18. Four grab samples of wood debris from the untreated grit

Table 2-10. WET-Soluble Metal Contents (STLC Analysis) of the Grit from Building PA44 Compared to the Untreated Grit in Pile

| Element | STLC Leachable Metal Concentration (mg/L) | |
|---|---|---|
| | PA44 Grit (average of 5 samples) | Untreated Grit |
| Cu | 8.7 | 144 |
| Pb | 6.4 | 19 |
| Sb | 0.56 | NA |
| As | 0.06 | 0.06 |
| Ba | 2.2 | 6.8 |
| Be | <0.1 | <0.03 |
| Cd | 0.18 | <0.06 |
| Cr (Total) | 1.5 | 2.0 |
| Cr(VI) | NA[a] | <1.0 |
| Co | 0.09 | <0.2 |
| Hg | <0.002 | <0.01 |
| Mo | 0.3 | <1.0 |
| Ni | 3.9 | 1.0 |
| Se | <0.05 | <0.01 |
| Ag | <0.1 | <0.05 |
| Tl | <2.0 | <0.3 |
| V | 0.06 | <1.0 |
| Zn | 32.6 | 146 |
| F | NA | NA |

(a) Not analyzed, Cr(VI) not present in this grit (Table 2-9).
Source: Means et al., 1993b.

Table 2-11. Mean TCLP Soluble Metal Contents of the Grit from Building PA44 Compared to the Untreated Grit in Pile

| Element | Total Metal Concentration (mg/L) | |
|---|---|---|
| | PA44 Grit (average of 5 samples) | Untreated Grit |
| Pb | 1.0 | 1.11 |
| As | <0.005 | <0.5 |
| Ba | 0.61 | <5 |
| Cd | 0.12 | <0.05 |
| Cr | 0.13 | <0.5 |
| Hg | 0.0004 | <0.02 |
| Se | <0.005 | <0.005 |
| Ag | <0.05 | <0.05 |

Source: Means et al., 1993b.

Table 2-12. Results of Total Metals Analysis (TTLC) of Sandblasting Grit Samples Collected by Vacuum Truck from Different Locations at Hunters Point Annex[a]

| Sample Number/ Site Number | Sample (values in mg/kg) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | TTLC[b] NA | PA57H-1 4A | PA57H-2 4B | PA26-1 1 | PA31-1 2 | IR14/15-1 17A | IR14/15-2 17B | IR20-N-1 3 | VAC-CS-1 Composite | Tarp Patches |
| Antimony | 500 | <1.2 | <1.2 | <1.2 | 2.6 | <1.2 | <1.2 | 5.6 | <1.2 | NA |
| Arsenic | 500 | 2.4 | 2.3 | <0.2 | 10 | <0.2 | <0.2 | <0.2 | <0.2 | NA |
| Barium | 10,000 | 71 | 100 | 8.8 | 4.4 | 8.0 | 14 | 44 | 26 | NA |
| Beryllium | 75 | 0.6 | 0.28 | 0.07 | 0.065 | 0.1 | 0.09 | 0.14 | 0.11 | NA |
| Cadmium | 100 | 1.8 | 2.4 | <0.5 | <0.5 | <0.5 | <0.5 | 2.8 | 1.5 | NA |
| Chromium (Total) | 2,500 | 9.4 | 42 | 22 | 5.9 | 97 | 34 | 58 | 24 | NA |
| Chromium-VI | 500 | — | — | — | — | — | — | — | — | NA |
| Cobalt | 8,000 | 13 | 18 | 1.5 | 1.9 | 6.0 | 1.7 | 4.9 | 2.2 | NA |
| Copper | 2,500 | **460** | **880** | 67 | 150 | **2,000** | **2,700** | **720** | **350** | 56 |
| Lead | 1,000 | 2.4 | **200** | **57** | 19 | 35 | 36 | **420** | **89** | 6.1 |
| Mercury | 20 | 0.067 | 0.074 | <0.05 | <0.05 | <0.05 | 0.12 | 0.081 | <0.05 | NA |
| Molybdenum | 3,500 | 7.6 | <25 | 2.1 | <0.25 | 3.2 | <2.5 | 6.5 | 2.8 | NA |
| Nickel | 2,000 | 5.0 | 15 | 3.5 | 13 | **390** | 4.2 | 27 | 27 | NA |
| Selenium | 100 | <0.5 | <0.5 | <0.5 | <0.5 | <5.0 | <0.5 | <0.5 | <0.5 | NA |
| Silver | 500 | 2.0 | 1.9 | 1.2 | 1.6 | 2.0 | 2.1 | 1.8 | 1.7 | NA |
| Thallium | 700 | <0.05 | <0.05 | <2.5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | NA |
| Vanadium | 2,400 | 25 | 31 | 2.6 | 1.8 | 4.2 | 3.8 | 14 | 4.3 | NA |
| Zinc | 5,000 | 55 | 360 | 160 | 18 | 71 | 690 | 1,900 | 540 | NA |

(a) Total concentrations that could lead to exceeding the STLC limit are shown in bold.
(b) From California Administrative Code, Title 22, Section 66699.
TTLC = Total Threshold Limit Concentration.

**Table 2-13. Results of Soluble Metals (WET Test) Analysis (STLC) of Sandblasting Grit Samples Collected by Vacuum Truck from Different Locations at Hunters Point Annex[(a)]**

| Sample Number/ Site Number | Sample (values in mg/L) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | STLC[(b)] | PA 57H-1 | PA 57H-2 | PA 26-1 | PA 31-1 | IR 14/15-1 | IR 14/15-2 | IR 20-N-1 | VAC-CS-1 |
| Antimony | 15 | | | | | | | | |
| Arsenic | 5 | | | | | | | | |
| Barium | 100 | | | | | | | | |
| Beryllium | 0.75 | | | | | | | | |
| Cadmium | 1 | | | | | | | | |
| Chromium (Total) | 560 | | | | | | | 3.0 | |
| Chromium-VI | 5 | <0.01 | 0.012 | <0.01 | <0.01 | <0.01 | <0.01 | 0.019 | 0.022 |
| Cobalt | 80 | | | | | | | | |
| Copper | 25 | <0.2 | <0.2 | | | 150 | 280 | 11.0 | 12 |
| Lead | 5 | | 11 | 3.3 | | 3.1 | | 26.0 | 2.7 |
| Mercury | 0.2 | | | | | | | | |
| Molybdenum | 350 | | | | | | | | |
| Nickel | 20 | | | | | 5.9 | | | |
| Selenium | 1 | | | | | | | | |
| Silver | 5 | | | | | | | | |
| Thallium | 7 | | | | | | | | |
| Vanadium | 24 | | | | | | | | |
| Zinc | 250 | | | | | | | | |

(a) WET test was only performed for those metals that had the potential for an STLC exceedance based on the total metals data (Table 2-12), taking into account the 10x dilution factor of the grit during the WET test. Consequently, a blank entry in this table indicates that an STLC exceedance was not possible.

(b) From California Administrative Code Title 22, Section 66699.

STLC = Soluble Threshold Limit Concentration.

## Table 2-14. Untreated Grit Volatile Organic Compound Data

| Parameter | Units | MDL | Concentration |
|---|---|---|---|
| Organic analysis — volatile organics, EPA Method 8240 GC/MS* | | | |
| Chloromethane | μg/kg | 10 | ND |
| Vinyl chloride | μg/kg | 10 | ND |
| Bromomethane | μg/kg | 10 | ND |
| Chloroethane | μg/kg | 10 | ND |
| Trichlorofluoromethane | μg/kg | 5 | ND |
| 1,1,2-Trichlor-1,2,2-trifluoroethane | μg/kg | 5 | ND |
| 2-Butanone (MEK) | μg/kg | 50 | ND |
| 1,1-Dichloroethene | μg/kg | 5 | ND |
| Carbon disulfide | μg/kg | 5 | ND |
| Acetone | μg/kg | 50 | ND |
| Methylene chloride | μg/kg | 5 | ND |
| *trans*-1,2-Dichloroethene | μg/kg | 5 | ND |
| *cis*-1,2-Dichloroethene | μg/kg | 5 | ND |
| 1,1-Dichloroethane | μg/kg | 5 | ND |
| Chloroform | μg/kg | 5 | ND |
| 1,1,1-Trichloroethane | μg/kg | 5 | ND |
| 1,2-Dichloroethane | μg/kg | 5 | ND |
| Carbon tetrachloride | μg/kg | 5 | ND |
| Benzene | μg/kg | 5 | ND |
| 1,2-Dichloropropane | μg/kg | 5 | ND |
| Trichloroethane | μg/kg | 5 | ND |
| Bromodichloromethane | μg/kg | 5 | ND |
| *trans*-1,2-Dichloropropene | μg/kg | 5 | ND |
| 4-Methyl-2-pentanone (MIBK) | μg/kg | 50 | ND |
| Toluene | μg/kg | 5 | 11 |
| *cis*-1,3,-Dichloropropene | μg/kg | 5 | ND |
| 1,1,2-Trichloroethane | μg/kg | 5 | ND |

## Table 2-14. Untreated Grit Volatile Organic Compound Data (continued)

| Parameter | Units | MDL | Concentration |
|---|---|---|---|
| Organic analysis — volatile organics, EPA Method 8240 GC/MS* (continued) | | | |
| Dibromochloromethane | μg/kg | 5 | ND |
| 2-Hexanone | μg/kg | 50 | ND |
| Tetrachloroethane | μg/kg | 5 | ND |
| Chlorobenzene | μg/kg | 5 | ND |
| Ethylbenzene | μg/kg | 5 | ND |
| Bromoform | μg/kg | 5 | ND |
| Xylene(s) total | μg/kg | 5 | ND |
| Styrene | μg/kg | 5 | ND |
| 1,1,2,2,-Tetrachloroethane | μg/kg | 5 | ND |
| 1,3-Dichlorobenzene | μg/kg | 5 | ND |
| 1,4-Dichlorobenzene | μg/kg | 5 | ND |
| 1,2-Dichlorobenzene | μg/kg | 5 | ND |
| 1,3-Dichloroethane-d4 (surrogate recovery) | | | 93% |
| Toluene-d8 (surrogate recovery) | | | 106% |
| 4-Bromofluorobenzene (surrogate recovery) | | | 94% |

MDL = Method Detection Limit.
ND = Not detected at or above the MDL.
Laboratory: Pace Incorporated, Novato, California.
*EPA in this table refers to U.S. EPA procedures using gas chromatography/mass spectrometry (GC/MS).
Source: Means et al., 1993a, Table 2-3.

## Table 2-15. Treated Grit Volatile Organic Compound Data

| Parameter | Units | MDL | Concentration |
|---|---|---|---|
| Chloromethane | μg/kg | 10 | ND |
| Vinyl chloride | μg/kg | 10 | ND |
| Bromomethane | μg/kg | 10 | ND |
| Chloroethane | μg/kg | 10 | ND |
| Trichlorofluoromethane | μg/kg | 5 | ND |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | μg/kg | 5 | ND |
| 2-Butanone (MEK) | μg/kg | 50 | ND |
| 1,1-Dichloroethene | μg/kg | 5 | ND |
| Carbon disulfide | μg/kg | 5 | ND |
| Acetone | μg/kg | 50 | ND |
| Methylene chloride | μg/kg | 5 | ND |
| *trans*-1,2-Dichloroethene | μg/kg | 5 | ND |
| *cis*-1,2-Dichloroethene | μg/kg | 5 | ND |
| 1,1-Dichloroethane | μg/kg | 5 | ND |
| Chloroform | μg/kg | 5 | ND |
| 1,1,1-Trichloroethane | μg/kg | 5 | ND |
| 1,2-Dichloroethane | μg/kg | 5 | ND |
| Carbon tetrachloride | μg/kg | 5 | ND |
| Benzene | μg/kg | 5 | ND |
| 1,2-Dichloropropane | μg/kg | 5 | ND |
| Trichloroethane | μg/kg | 5 | ND |
| Bromodichloromethane | μg/kg | 5 | ND |
| *trans*-1,3-Dichloropropene | μg/kg | 5 | ND |
| 4-Methyl-2-pentanone (MIBK) | μg/kg | 50 | ND |
| Toluene | μg/kg | 5 | 9 |
| *cis*-1,3-Dichloropropene | μg/kg | 5 | ND |
| 1,1,2-Trichlorethane | μg/kg | 5 | ND |
| Dibromochloromethane | μg/kg | 5 | ND |

## Table 2-15. Treated Grit Volatile Organic Compound Data (continued)

| Parameter | Units | MDL | Concentration |
|---|---|---|---|
| Organic analysis — volatile organics, EPA Method 8240 GC/MS* (continued) | | | |
| 2-Hexanone | μg/kg | 50 | ND |
| Tetrachloroethane | μg/kg | 5 | ND |
| Chlorobenzene | μg/kg | 5 | ND |
| Ethylbenzene | μg/kg | 5 | ND |
| Bromoform | μg/kg | 5 | ND |
| Xylene(s) total | μg/kg | 5 | ND |
| Styrene | μg/kg | 5 | ND |
| 1,1,2,2-Tetrachloroethane | μg/kg | 5 | ND |
| 1,3-Dichlorobenzene | μg/kg | 5 | ND |
| 1,4-Dichlorobenzene | μg/kg | 5 | ND |
| 1,2-Dichlorobenzene | μg/kg | 5 | ND |
| 1,2-Dichloroethane-d4 (surrogate recovery) | | | 96% |
| Toluene-d8 (surrogate recovery) | | | 104% |
| 4-Bromofluorobenzene (surrogate recovery) | | | 89% |

MDL = Method Detection Limit
ND = Not detected at or above the MDL.
Laboratory: Pace Incorporated, Novato, California
*EPA in this table refers to U.S. EPA procedures using gas chromatography/mass spectrometry (GC/MS).
Source: Means et al., 1993a, Table 2-3.

**Table 2-16. Summary of Average Butyltin Analyses**

| Sample | Butyltin Chloride Concentrations (mg/kg) | | |
|---|---|---|---|
| | Mono- | Di- | Tri- |
| Untreated grit[a] | 22.4 | 15.0 | 70.7 |

(a) GC (gas chromatography) analysis.

**Table 2-17. Chemical Data on Debris Samples from Hunters Point Annex**

| Sample ID/Type | TTLC[a] (mg/kg) | | STLC[b] (mg/L) | |
|---|---|---|---|---|
| | Cu | Pb | Cu | Pb |
| DEB-1/wood | 1,100 | 270 | 83 | 6.7 |
| DEB-2/wood | 150 | 53 | 74 | 9.5 |
| DEB-3/wood | 790 | 170 | 14 | 2.3 |
| DEB-4/cloth | 2,900 | 730 | 42 | 20 |
| DEB-5/cloth | 940 | 560 | 170 | 20 |
| DEB-6/cloth | 4,700 | 970 | 200 | 74 |
| DEB-7/metal | 1,300 | 93 | 1.6 | 6.7 |
| DEB-8/metal | 460 | 1,100 | 0.12 | 2.5 |
| DEB-9/metal | 1,100 | 470 | 0.13 | 1.1 |

(a) TTLC limits for copper and lead are 2,500 mg/kg and 1,000 mg/kg, respectively.
(b) STLC limits for copper and lead are 25 mg/L and 5 mg/L, respectively.

**Table 2-18. TCLP Pb Data on Cloth Debris**

| Sample # | TCLP Pb (mg/L) |
|---|---|
| Cloth-1 | 0.9 |
| Cloth-2 | 6.3 |
| Cloth-3 | 4.1 |
| Avg. ± stan. dev. | 3.8 ± 2.7 |

Table 2-19. TTLC and STLC Pb and Cu and TCLP Pb Data on Wood Debris

| | TTLC (mg/kg) | | STLC (mg/L) | | TCLP (mg/L) |
|---|---|---|---|---|---|
| Sample # | Cu | Pb | Cu | Pb | Pb |
| Wood-1 | 860 | 270 | 33 | 7.4 | <0.5 |
| Wood-2 | 2,700 | 620 | 190 | 12 | <0.5 |
| Wood-3 | 2,000 | 310 | 90 | 8.5 | <0.5 |
| Wood-4 | 1,800 | 150 | 61 | 4.4 | <0.5 |
| Avg. ± stan. dev. | 1,840 ± 760 | 340 ± 200 | 94 ± 68 | 8.1 ± 3.1 | <0.5 |

pile were analyzed for total and WET-soluble Pb and Cu and TCLP Pb. The results are presented in Table 2-19.

Debris analysis results indicate that the debris are hazardous waste. When debris are separated from the untreated grit in preparation for grit recycling, the resulting debris will need to be managed as hazardous waste.

## 2.4 Asbestos Analyses

Two grab samples of untreated grit collected at random from the large grit pile were analyzed for asbestos using optical microscopy. Asbestos was not detected in either sample.

## 2.5 Matrix Properties

Samples of untreated and sulfide-treated grit were characterized using standard sieve grain-size analyses. The results are shown in Table 2-20. The correspondences of the measured size

Table 2-20. Hunters Point Grit Sieve-Size Analysis

| Sulfide-Treated Grit | | | | Untreated Grit | | | |
|---|---|---|---|---|---|---|---|
| Sieve Size | Weight (grams) | Cum% | Ind% | Sieve Size | Weight (grams) | Cum% | Ind% |
| −2.5 | 25.1 | 2.04 | 2.04 | −2.5 | 37.8 | 2.98 | 2.98 |
| −1.0 | 39.0 | 5.22 | 3.18 | −1.0 | 53.5 | 7.20 | 4.22 |
| 0 | 264.5 | 26.77 | 21.55 | 0 | 477.2 | 44.86 | 37.66 |
| +1 | 502.3 | 67.62 | 40.85 | +1 | 552.2 | 88.44 | 43.58 |
| +2 | 304.6 | 92.52 | 24.9 | +2 | 117.0 | 97.67 | 9.23 |
| +3 | 73.2 | 98.24 | 5.72 | +3 | 23.0 | 99.49 | 1.83 |
| +3+ | 18.6 | 100.00 | 1.76 | +3+ | 6.4 | 100.00 | 0.51 |

ranges to standard sieve size, actual mesh opening, and Wentworth soil size class are shown in Table 2-21. Both the untreated and sulfide-treated grits are classified as coarse sand. The sulfide-treated grit has a higher proportion of fines due to the addition of fly ash during the chemical stabilization demonstration. Both grits are classified as coarse sand (see Table 2-21).

## 2.6 Radioactivity Monitoring

Monitoring for radioactivity was performed at both the untreated and treated grit piles. After each pile was uncovered and material was removed and loaded into material bins for the field demonstration, the exposed area of each pile was monitored for radioactivity. An Eberline E-120 Geiger counter was used to detect gamma radiation, and an Eberline PAC-463 meter was used to detect any alpha or beta radiation. No activity was noted above background levels in the areas that were monitored.

**Table 2-21. Particles Sizes Corresponding to Sieve Mesh #**

| | U.S. Standard Sieve Mesh # | Millimeters | Phi $\phi$ | Wentworth Size Class |
|---|---|---|---|---|
| Gravel | Use wire square | 4,096 | −12 | Boulder (−8 to −12$\phi$) |
| | | 1,024 | −10 | |
| | | 256 | −8 | |
| | | 64 | −6 | Cobble (−6 to −8$\phi$) |
| | | 16 | −4 | Pebble (−2 to −6$\phi$) |
| | 5 | 4 | −2 | |
| | 6 | 3.35 | −1.75 | Granule |
| | 7 | 2.80 | −1.5 | |
| | 8 | 2.36 | −1.25 | |
| | 10 | 2.00 | −1.0 | |
| Sand | 12 | 1.7 | −0.75 | Very coarse sand |
| | 14 | 1.4 | −0.5 | |
| | 16 | 1.18 | −0.25 | |
| | 18 | 1.00 | 0.0 | |
| | 20 | 0.85 | 0.25 | Coarse sand |
| | 25 | 0.71 | 0.5 | |
| | 30 | 0.60 | 0.75 | |
| | 35 | 0.50 | 1.0 | |

Table 2-21. Particles Sizes Corresponding to Sieve Mesh # (continued)

| | U.S. Standard Sieve Mesh # | Millimeters | Phi $\phi$ | Wentworth Size Class |
|---|---|---|---|---|
| Sand (cont'd) | 40 | 0.425 | 1.25 | Medium sand |
| | 45 | 0.355 | 1.5 | |
| | 50 | 0.300 | 1.75 | |
| | 60 | 0.250 | 2.0 | |
| | 70 | 0.212 | 2.25 | Fine sand |
| | 80 | 0.180 | 2.5 | |
| | 100 | 0.150 | 2.75 | |
| | 120 | 0.125 | 3.0 | |
| | 140 | 0.106 | 3.25 | |
| | 170 | 0.090 | 3.5 | Very fine sand |
| | 200 | 0.075 | 3.75 | |
| | 230 | 0.063 | 4.0 | |
| | 270 | 0.053 | 4.25 | |
| Mud | 325 | 0.045 | 4.5 | Coarse silt |
| | Analyzed by Pipette or Hydrometer | 0.038 | 4.75 | |
| | | 0.032 | 5.1 | |
| | | 0.0156 | 6.0 | Medium silt |
| | | 0.0078 | 7.0 | Fine silt |
| | | 0.0039 | 8.0 | Very fine silt |
| | | 0.0020 | 9.0 | Clay |
| | | 0.00098 | 10.0 | |
| | | 0.00049 | 11.0 | |
| | | 0.00024 | 12.0 | |
| | | 0.00012 | 13.0 | |
| | | 0.00006 | 14.0 | |

# 3.0 REGULATORY COMPLIANCE

On August 18, 1995, the California Department of Toxic Substances Control (DTSC) Resource Recovery Section issued a management memo for "Use Constituting Disposal" (Appendix C). The purpose of this management memo is to encourage the recycling of suitable waste materials into construction materials and to establish conditions to assure that the recycling occurs safely and can be monitored as necessary to prevent abuses. The memo ratifies an earlier draft policy issued on September 26, 1990. The management memo applies to any recyclable material that is placed on the land or used to produce a product that is placed on the land. Using spent sandblasting grit as asphalt aggregate clearly fits within the scope of the management memo. A California hazardous material reused in a manner constituting disposal is regulated under the California Health and Safety Code (HSC), Section 25143.2(e)(2) unless certain conditions are met. Several of these conditions, which are described more fully in Appendix C, are as follows:

1. Policy only applies to non-RCRA (California-only) hazardous wastes.

2. Hazardous constituents with a concentration greater than or equal to the regulatory STLC shall have chemically reacted or become physically bound so as not to leach from the product in concentrations above the applicable STLC, once the effect or dilution by other ingredients is taken into account.

3. Recyclable composites should add no significant hazard to public health or the environment, either in the recycling process or in the final product.

4. The recyclable composites must met Caltrans specifications or equivalent for proposed use and must be made for commercial use.

A memo from the DTSC indicating that reuse of spent sandblasting grit from HPA meets conditions to be exempt from classification as a waste under HSC Section 25143.2(d)(5) is included as Appendix D. This memo also includes excerpts from California's Hazardous Waste Recycling Laws.

Safely meeting the conditions to exempt grit recycling from regulation as a California hazardous waste is one major goal in allowing responsible and cost-effective management of the grit. As a part of meeting those conditions, protection of worker safety and health and the protection of air, surface water, and groundwater also must be considered. These other environmental protection aspects include obtaining review, concurrence, and/or permits from a wide range of regulatory agencies as well as published public announcements to invite stakeholder input. Project efforts included numerous communications with regulatory agencies such as the Glenn County Department of Health, the Glenn County Air Pollution Control District, the Regional Water Quality Control Board, the California Air Resources Board, and the DTSC. The overall regulatory interactions for the project are summarized in Figure 3-1. These interactions include a number of phone calls and distribution of project documentation, such as the project work plan and data report. Also, letters were written to the following: Greg Lindholm of the Glenn County Department of Health, to clarify the project; Jessie Schnell of DTSC, to request a letter from her office indicating that this project is in compliance with department policy; and Dave Song of Western Division (WESTDIV), as input for a public announcement.

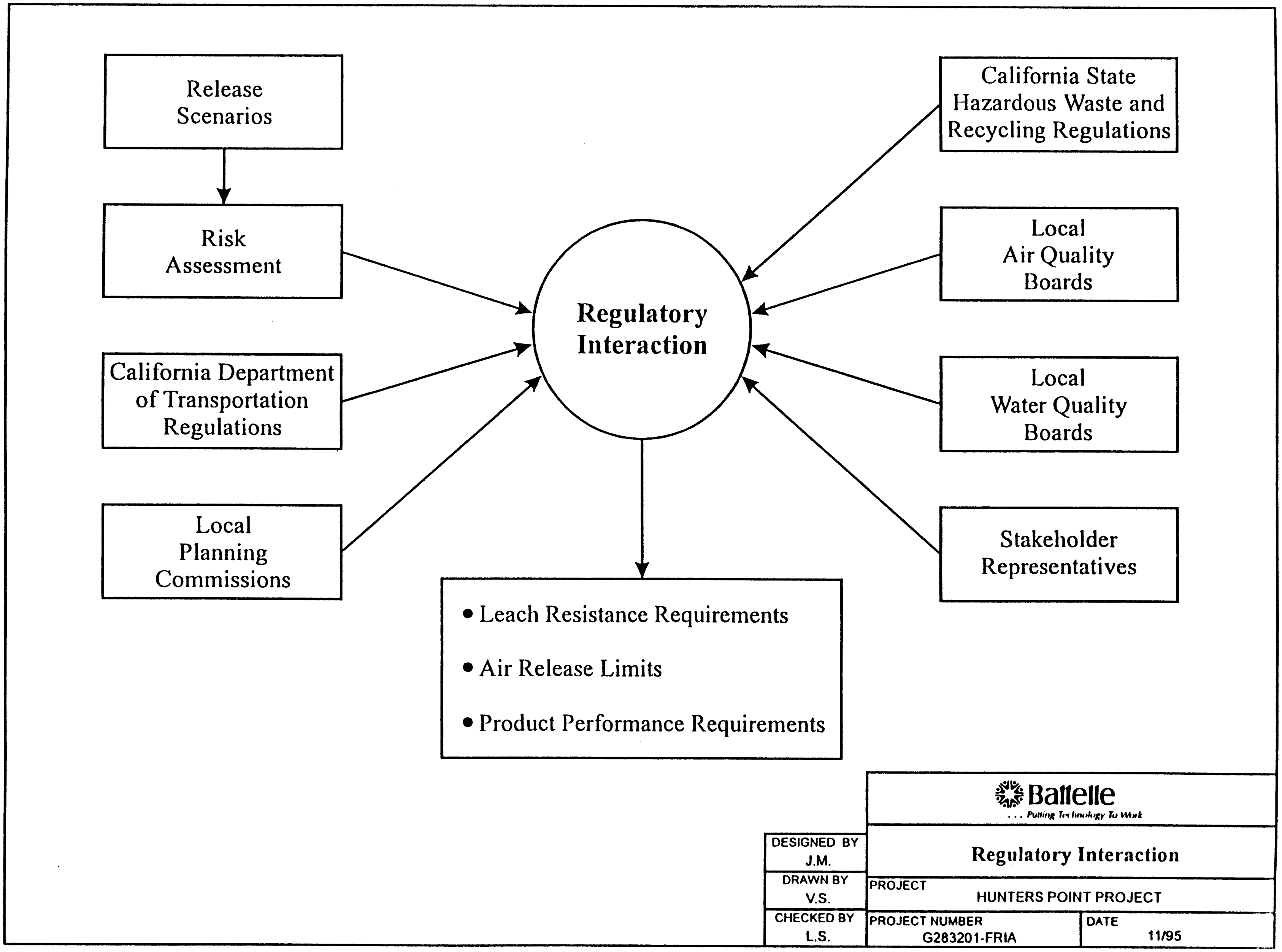



**Figure 3-1. Regulatory Interactions for Spent Sandblasting Grit Recycling Project.**

Examples of regulatory concurrence documents are provided in Appendices D-1 through D-4. Appendix D-1 shows the concurrence of the California DTSC with the proposed use of spent sandblasting grit from HPA as qualifying for a recycling exclusion. In addition to the DTSC concurrence for the recycling exclusion, local Air and Water Boards also reviewed and concurred with the field demonstration project (see Sections 7.0 and 8.0). The Bay Area Air Quality Management District (BAAQMD) reviewed the planned operations for screening and crushing the spent sandblasting grit at HPA and determined that a permit was not required because the operation was occurring at a federal facility under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), but that the technical requirements of BAAQMD regulations should be followed (Appendix D-2). The Central Valley Region of the California Regional Water Quality Control Board did not require permit application due to the determination by the DTSC that the recycling activity qualified for an exclusion (Appendix D-3). The Glenn County Air Pollution Control Division (GCAPCD) required performance of a risk screening analysis. The California Air Resources Board (CARB) performed the modeling (Appendix D-4) and determined that the worst-case lead concentration was well below regulatory standards and was not expected to cause any adverse human health effects.

The Glenn County Planning Department provided a Conditional Use Permit based on the Orland asphalt plans (Appendix E-1) for using spent sandblasting grit from HPA in the field demonstration. The original Conditional Use Permit and two extensions are provided as Appendices E-2 through E-4.

As described in Sections 4 through 8, the sequence of bench-scale treatability testing, pilot-scale testing, and full-scale field demonstration was organized and conducted to regulatory, scientific, and economic bases to demonstrate the acceptability of reusing spent sandblasting grit as asphalt aggregate. The testing program was designed to show that grit reuse could be done while protecting human health and the environment, meeting regulatory requirements, producing good quality asphalt, and providing an economically viable way to recycle rather a material that would otherwise be a waste.

# 4.0 TREATABILITY TESTING

This section gives an overview of testing performed in previous projects to develop an effective asphalt formulation for recycling spent sandblasting grit. The treatability study was designed in late 1990 and conducted in early 1991 (Means, 1990).

## 4.1 Treatability Study Sample Preparations

Bench-scale treatability tests were performed to evaluate the leaching resistance and project quality of the asphalt produced with HPA grit as an additive and to determine an acceptable mix of ingredients (bitumen, aggregate, and grit) for the asphalt. Test samples were produced at Reed and Graham Asphalt of San Jose, California. Physical and chemical tests were run on the asphalt-treated grit test samples at California-certified laboratories. Samples of both the untreated and sulfide-treated grits were evaluated.

The aggregate grading requirements for the coarse aggregate, fine aggregate, and spent sandblasting grit conformed to the California Department of Transportation (Caltrans) Section 39 (see Appendix F) and any pertinent local requirements. The aggregate grading used was 0.5-inch maximum, medium type B (see Caltrans Section 39). Asphalt-treated grit mixtures containing 46% and 7% of untreated and sulfide-treated sandblasting grit were tested in the bench-scale tests. Sandblasting grit of a size less than No. 8 mesh was used in the test. For simplicity, the asphalt-treated grit mixtures will be referred to as 46% mix (untreated and sulfide-treated) and 7% mix (untreated and sulfide-treated).

The asphalt-treated grit mixtures were prepared at 350°F. The asphalt mixtures at this temperature had a viscosity of 170 ± 20 centistokes (ASTM D1559, 1989). The mass of the asphalt required is about 4.5 to 6.5% of the total weight of the asphalt-treated grit mixture. For the 46% mix, the mass of asphalt used was 5.5% of the total weight of the mixture. Three different asphalt contents (5.3, 5.8, and 6.3%) were used for the 7% mix. About 1.5 kg of each asphalt-treated grit mixture was prepared for the physical properties and chemical leaching tests.

## 4.2 Treatability Study Testing Methods

### 4.2.1 Chemical Test Methods

Three chemical leaching tests were conducted on the asphalt samples containing recycled grit. The chemical tests were the CAL WET, to determine whether the cured asphalt-treated grit mixtures met the California Soluble Threshold Limit Concentration (STLC) criterion for heavy metals; the TTLC test, to verify that the cured asphalt-treated grit mixture adhered to the TTLC criterion; and the TCLP, to ensure that the RCRA leachable toxicity criterion was not exceeded.

### 4.2.2 Product Quality Test Methods

The Hveem Method (ASTM D1560) was the physical property test suite used to establish product quality for the asphalt treatability test samples. Data collected from the Hveem Method include (1) bitumen or asphalt content, (2) stabilimeter value, (3) cohesiometer value, (4) test temperature, (5) density of asphalt-treated grit mixture, and (6) air voids ratio.

The Hveem Method currently is adopted by Caltrans and involves two principal tests. The first test, the stabilimeter test, is a type of triaxial test that determines the resistance to deformation of compacted asphalt mixtures by measuring the lateral pressure developed when applying a vertical load using the Hveem stabilimeter. The second test, the cohesiometer test, determines the cohesion of the compacted asphalt mixtures by measuring the force required to break or bend the sample as a cantilever beam using the Hveem cohesiometer. Other information obtained from the cohesiometer test are the density and air void properties of the asphalt-treated grit mixture.

The centrifuge kerosene equivalent (CKE) test (ASTM D5148) was conducted on the 7% mix. The purpose of this test is to estimate the optimum asphalt content of the asphalt-treated grit mixture. Results of this test were then used to conduct the stabilimeter and cohesiometer tests at the estimated optimum asphalt content, and at greater and lesser asphalt contents, in order to establish and verify the optimum asphalt content. The CKE test consists of saturating with kerosene aggregates of the mixture that pass the No. 4 sieve (considered as the fine aggregate fraction) and then centrifuging at 400 g. The ⅜-inch to No. 4 size aggregate, considered to be the coarse fraction, is saturated with lubricating oil (SAE No. 10 oil or Shell Tellus No. 100 oil) and allowed to drain for 15 minutes at 140°F. Various K factors, $K_c$ (for coarse fraction) and $K_f$ (for fine fraction), are determined from the weight of kerosene and oil retained in the aggregates. From the K factors, the approximate bitumen ratio (ABR) or the optimum asphalt content is read from several plots found in the ASTM standard.

## 4.3 Treatability Study Test Results

The treatability testing provided information about the leach resistance and physical properties of the product asphalt.

### 4.3.1 Chemical Test Results

The results of the chemical leach tests for the 46% and 7% mixes are presented in Tables 4-1 and 4-2, respectively. As expected, the TTLC Pb and Cu levels for both mixes were reduced in proportion to the dilution of the grit with aggregate and asphalt. In the case of the 46% mix, the STLC for Pb was below regulatory levels; however, the STLC Cu concentration was about 1.5 times higher than the regulatory level of 25 mg/L. STLC Pb and Cu levels for the 7% mix were below the regulatory limits.

In contrast to the TTLC Pb and Cu levels, the STLC Pb and Cu levels for the mixes were reduced in greater proportion to the dilution of the grit with aggregate and asphalt. Reduction of leachable metal levels indicates that Pb and Cu in the grit were immobilized to a certain extent by the asphalt treatment. The TCLP levels for Pb and Cr for treated and untreated grit were less than the regulatory levels even before the brit was recycled into the asphalt-treated grit mixture. The TCLP levels for Pb and Cr therefore would meet regulatory limits after the grit is recycled into asphaltic concrete.

Table 4-1. Treatability Test Leaching Results (46% Mix)

| | TTLC (mg/kg) | | STLC (mg/L) | | TCLP (mg/L) | |
|---|---|---|---|---|---|---|
| | Pb | Cu | Pb | Cu | Pb | Cr (Total) |
| Untreated Grit | | | | | | |
| Before recycling into asphalt | 316 | 2,180 | 12.8 | 140 | 1.5 | 0.22 |
| After recycling into asphalt | 174 | 974 | 0.44 | 38.5 | 0.18 | 0.011 |
| Treated Grit | | | | | | |
| Before recycling into asphalt | 147 | 1,230 | 13.2 | 78.2 | 1.7 | 0.21 |
| After recycling into asphalt | 118 | 985 | 0.58 | 44.5 | 0.43 | 0.041 |

TTLC limits (mg/kg): Pb = 1,000; Cu = 2,500.
STLC limits (mg/L): Pb = 5; Cu = 25.
TCLP limits (mg/L): Pb = 5; Cr = 5.
Source: Means et al., 1995.

### 4.3.2 Product Quality Test Results

The results for the product quality tests for asphaltic concrete samples containing 46% and 7% recycled grit are shown in Table 4-3. Tests were done with both untreated spent grit and sulfide-treated grit.

Stabilimeter test results for the 46% mix (untreated) were below the acceptable Caltrans test limit criteria, but the cohesiometer value exceeded the test limit criteria. The percent voids value also

Table 4-2. Treatability Test Leaching Results (7% Mix)

| | TTLC (mg/kg) | | STLC (mg/L) | | TCLP (mg/L) | |
|---|---|---|---|---|---|---|
| | Pb | Cu | Pb | Cu | Pb | Cr (Total) |
| Hunters Point Untreated Grit | | | | | | |
| Before Recycling into Asphalt | 316 | 2,180 | 12.8 | 140 | 1.5 | 0.22 |
| After Recycling into Asphalt | | | | | | |
| Uncrushed Pellet | 18 | 118 | 0.076 | 2.8 | | |
| Crushed Pellet | 31 | 179 | <0.05 | 4.4 | | |
| Hunters Point Treated Grit | | | | | | |
| Before Recycling into Asphalt | 118 | 1,230 | 13.2 | 78.2 | 1.7 | 0.21 |
| After Recycling into Asphalt | | | | | | |
| Uncrushed Pellet | 21 | 109 | 0.18 | 3.9 | | |
| Crushed Pellet | 19 | 132 | 0.084 | 5.8 | | |

TTLC limits (mg/kg); Pb = 1,000; Cu = 2,500.
STLC limits (mg/L); Pb = 5; Cu = 25.
TCLP limits (mg/L); Pb = 5; Cr = 5.
Source: Means et al., 1995.

**Table 4-3. Treatability Test Product Quality Results (Hveem Test) for 48% and 7% Mixes**

| Sandblasting Grit Content | 46% | | 7% | | | | | | Acceptance Criteria (Medium Traffic) |
|---|---|---|---|---|---|---|---|---|---|
| **Quality Test Parameter** | **Untreated** | **Sulfide-Treated** | **Untreated** | | | **Sulfide-Treated** | | | |
| Asphalt Content (%) | 5.5 | 5.5 | 5.3 | 5.8 | 6.3 | 5.3 | 5.8 | 6.3 | |
| Stabilimeter | 31 | 46 | 42 | 38 | 31 | 36 | 34 | 29 | 35 (min)[a] |
| Cohesiometer | 379 | 374 | 369 | — | — | 372 | — | — | 50 (min)[b] |
| Percent Voids | 3.3 | 7.6 | — | — | — | — | — | — | 4 (min) to 8 (max)[c] |

(a) Caltrans criteria for medium-traffic applications.
(b) Asphalt Institute (1962) criterion.
(c) Asphalt Institute (1962) criterion; minimum value for Hveem Test, maximum value as listed for Marshall Test. Note that there is no maximum percent voids value for the Hveem Test in the Asphalt Institute (1962) criterion.
Source: Means et al., 1995.

was below the minimum test limit criteria. However, samples from the 46% mix (sulfide-treated) met the acceptable test limit criteria for the Hveem test.

A decrease in the stabilimeter value was observed for the 7% mix (untreated and sulfide-treated) when the asphalt content was increased from 5.3 to 6.3%. The Caltrans test limit criterion was satisfied by the untreated grit with asphalt contents of 5.3 and 5.8%, whereas for the sulfide-treated grit an asphalt content of 5.3% or less is required. Both types of grit (untreated and sulfide-treated) for this asphalt-treated grit mixture met the cohesiometer test limit criterion. The percent voids test for the 7% mix was not conducted.

The K factors from the CKE test are presented in Table 4-4. Both untreated and sulfide-treated grit for the 7% mix meet the Caltrans criteria for $K_c$ and $K_f$. The computed ABR or optimum

**Table 4-4. Centrifuge Kerosene Equivalent Test for 7% Mix**

| | Untreated | Sulfide-Treated | Acceptance Criteria (Medium Traffic) |
|---|---|---|---|
| $K_c$ factor | 1.4 | 1.4 | 1.7 (max)[a] |
| $K_f$ factor | 1.1 | 1.3 | 1.7 (max)[a] |
| Surface area of aggregate ($ft^2$/lb) | 34.2 | 29.5 | — |
| Approximate bitumen ratio (ABR) | 4.8% | 4.8% | — |
| ABR (corrected for AR 4000 asphalt) | 5.8% | 5.8% | — |

(a) Caltrans criteria.
Source: Means et al., 1993a.

asphalt content after correcting for the asphalt type (AR 4000) was 5.8% for both untreated and sulfide-treated grit. This percent of asphalt content is within the range of the asphalt content used for the Hveem test that met the Caltrans test limits.

## 4.4 Fate of Butyltin Compounds During Asphalt Process

Butyltin compounds are present as paint chip components in the spent sandblasting grit. The fate of butyltin compounds during heating to make asphaltic concrete and the leach resistance of butyltin compounds in the asphalt to leaching were studied.

A number of grit samples have been analyzed for butyltin compounds, including untreated grit, untreated and sulfide-treated grit heated to 325°F, and TCLP extracts of the untreated and sulfide-treated grit heated to 325°F. The analytical results are summarized in Table 4-5.

The HPA grit contains low levels of butyltin compounds, including monobutyltin (MBT), dibutyltin (DBT), and tributyltin (TBT). Heating to 325°F, such as occurs during asphalt production, did not appear to degrade or volatilize the DBT compound. There is some evidence of removal of the MBT and TBT compounds. The TCLP extracts of the heated grit also show the presence of butyltin compounds.

**Table 4-5. Summary of Average Butyltin Analyses**

| Sample/Treatment | Butyltin Chloride Concentrations (mg/kg) | | |
|---|---|---|---|
| | Mono- | Di- | Tri- |
| Untreated grit[a] | 22.4 | 15.0 | 70.7 |
| Grit heated to 325°F[b] | | | |
| Untreated | 7.8 | 31.6 | 13.9 |
| Sulfide-treated | 8.2 | 12.9 | 15.0 |
| TCLP extracts of heated grits[a] | | | |
| Untreated | 0.23 | 1.18 | 0.18 |
| Sulfide-treated | 0.23 | 0.82 | 0.64 |
| Blanks for above 3 sets of analyses | 0.23 | 0.01 | 0.003 |
| TCLP extract of untreated grit made into asphaltic concrete[c] | ND | 0.000096 | 0.000100 |
| TCLP extract of sulfide-treated grit made into asphaltic concrete | 0.000464 | 0.000066 | 0.000100 |

(a) Gas chromatography (GC) analysis.
(b) Gas chromatography/mass spectrometry (GC/MS) analysis.
(c) Hydride generation analysis.
ND = not detected.
Source: Means et al., 1993a, Table 1-4.

The final test involved the analysis of TCLP extracts from untreated and sulfide-treated grit made into asphalt test specimens. The results are shown in the last two lines of Table 4-5. The butyltin levels in these TCLP extracts are extremely low, in the nanogram per liter (part per trillion) range. Therefore, it appears that the butyltin compounds are being destroyed or transformed to a nonreleasable form when the spent sandblasting grit is processed with heated bitumen to form asphalt.

## 4.5 Regulatory Significance of Treatability Results

The results of the treatability tests indicate that recycling of spent sandblasting grit as aggregate in asphaltic concrete is a potentially effective and implementable management option. Both chemical leaching resistance and physical performance parameters were satisfactory for the 7% grit mixture.

The California Department of Toxic Substances Control (DTSC) regulatory chemical leach test requirements (CCR, Title 22, Chapter 11, Section 66261.24) also can be satisfied through dilution by selecting the appropriate asphalt/aggregate/grit mix. The 7% grit mix passes the chemical criteria limits by a margin that allows for some heterogeneity in the composition of the asphalt-treated grit. Physical tests have shown that the Caltrans or Asphalt Institute performance criteria can be met by selecting the appropriate asphalt/aggregate/grit mixtures and by varying the asphalt content in the mixture.

# 5.0 PILOT-SCALE ASPHALT MIXING AND PLACEMENT

This section gives an overview of testing performed in previous projects to demonstrate the feasibility of recycling spent sandblasting grit and prepare small test sections to allow testing of the long-term effectiveness of the asphalt formulation.

As discussed in the following sections, three asphaltic concrete test strips were laid on an existing stretch of road at HPA along Spear Avenue between Morell and Cochrane Streets in November 1991. The long-term stability of these test strips was studied for several years (see Section 6.0) to accumulate data on the leaching resistance and physical integrity of asphaltic concrete containing about 5% spent sandblasting grit as part of the aggregate.

## 5.1 Background Characterization at Pilot-Scale Test Strip Site

The area where the test strips were laid was analyzed for background metals content to determine baseline metals concentration. Elevated levels of metallic contaminants might interfere with the long-term stability analyses done periodically to measure changes in the metal leaching resistance or content of the asphaltic concrete.

Three background soil samples were collected from the surface adjacent to the edge of each planned test strip, resulting in nine samples total. The nine samples were collected in the area of the roadgrinding test strips along Spear Avenue between Horne Avenue and Cochrane Street. Three additional samples were collected from on the hillside just parallel to the three long-term test strips located on Fisher Avenue. Sampling locations are shown in Figure 5-1. Samples were collected using a stainless steel scoop and tested for TTLC Pb and Cu, STLC Pb and Cu, and TCLP Pb and Cr by a California-certified analytical testing laboratory.

Based on the results in Table 5-1, it is apparent that several of the samples from the vicinity of Spear Avenue and all three of the samples from the hillside adjacent to Fisher Avenue contain elevated levels of Cu and/or Pb, the principal metals in the asphalt-treated sandblasting grit. Therefore, in future sampling of the asphalt test strips for purposes of chemical analyses, asphalt cores will be washed thoroughly prior to analysis to remove any contaminated dirt.

## 5.2 Hydrogen Sulfide Monitoring

The sulfide-treated pile was monitored in the field for hydrogen sulfide ($H_2S$). The grit in this pile had been treated with small amounts of sodium hydrosulfide during the stabilization/solidification demonstration of December 1989. During the excavation of the treated pile, a Gastech GX-91 $H_2S$ monitor was used to ensure that $H_2S$ concentrations did not pose a safety hazard to the sampling team.

Levels detected at the bottom of the treated pile with the monitor probe just one inch above material ranged from 2 to 7 ppm, but dissipated quickly. The maximum level of $H_2S$ detected was 0.5 ppm in the area of the personnel doing work near the excavation, compared to an action level of 5.0 ppm.

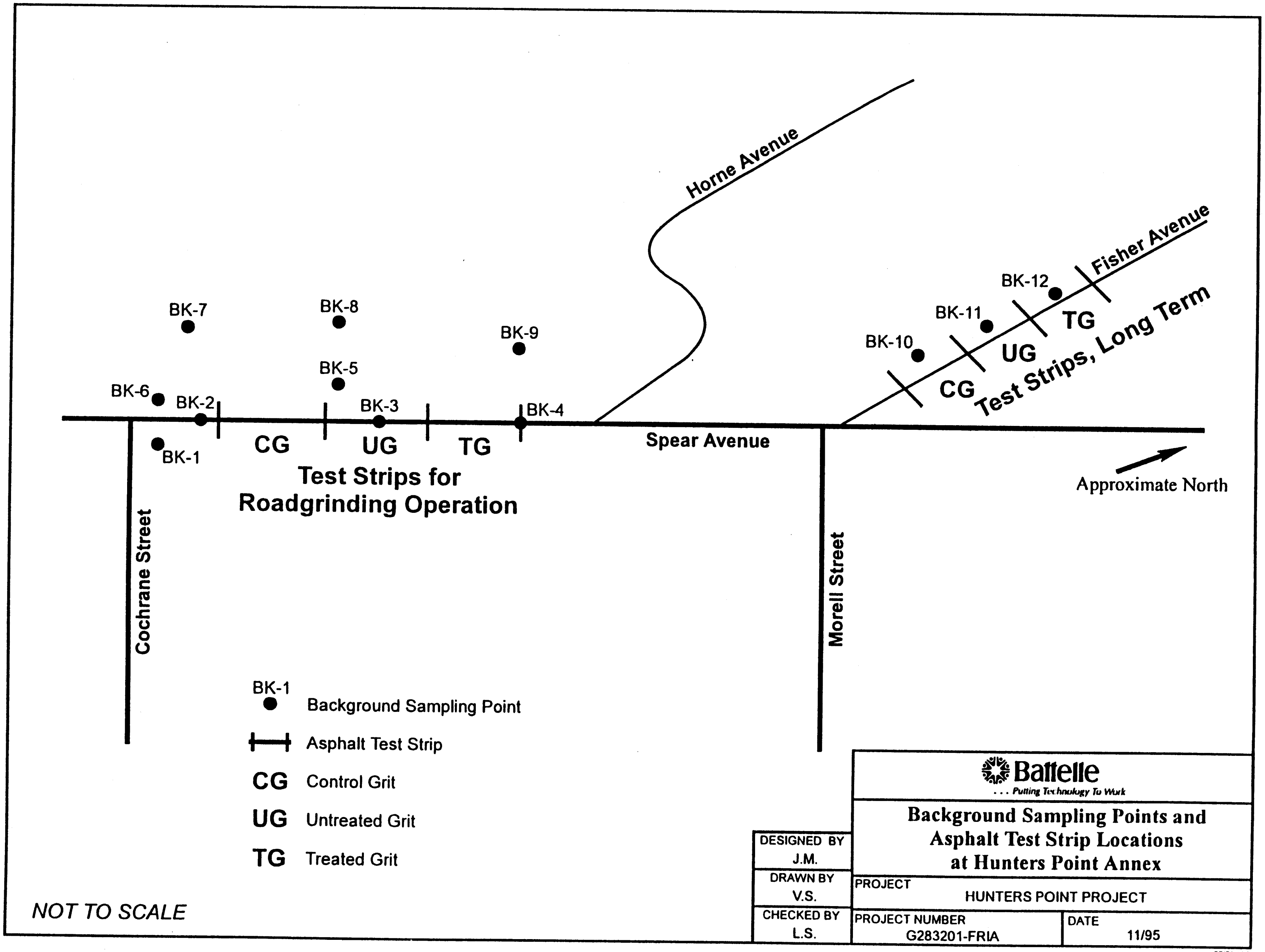



**Figure 5-1. Background Sampling Points and Asphalt Test Strip Locations at Hunters Point Annex.**

**Table 5-1. Chemical Data on Threshold Soils at Hunters Point Annex**

| Sample ID | Total (mg/kg) | | | WET-soluble (mg/L) | | TCLP (mg/L) | |
|---|---|---|---|---|---|---|---|
| | Cu | Pb | Cr | Cu | Pb | Cu | Pb |
| BK-1 | 350 | 510 | — | 7.5 | 1.9 | 0.51 | 1.4 |
| BK-2 | * | * | — | 0.22 | 0.71 | 0.08 | 0.6 |
| BK-3 | 20 | 30 | — | 0.24 | 1.4 | 0.03 | 0.1 |
| BK-4 | 190 | 490 | — | 6.5 | 17 | 0.12 | 0.2 |
| BK-5 | 1,800 | 560 | — | 110 | 22 | 19 | 1.4 |
| BK-6 | 65 | 80 | — | 1.6 | 1.8 | 0.03 | 0.1 |
| BK-7 | 47 | 67 | — | 1.4 | 2.3 | 0.02 | 0.1 |
| BK-8 | 53 | 50 | — | 1.3 | 1.8 | 0.01 | 0.1 |
| BK-9 | 53 | 60 | — | 1.2 | 1.4 | 0.01 | 0.1 |
| BK-10 | 110 | 320 | 68 | — | — | — | — |
| BK-11 | 94 | 2,500 | 79 | — | — | — | — |
| BK-12 | 82 | 250 | 71 | — | — | — | — |

* Insufficient sample available for analysis.

## 5.3 Permits and Variances

This pilot-scale field demonstration was conducted under a research and development (R&D) variance from California EPA, DTSC. A copy of that variance is provided in Appendix G. Also, the Bay Area Air Quality Management District (BAAQMD) issued an Experimental Exemption to cover field demonstration activities at the Reed and Graham, Inc. asphalt plant in San Jose. A copy of this exemption is provided in Appendix H.

## 5.4 Grit Excavation at HPA and Transport to the Asphalt Plant

The loading and transport of grit from HPA to Reed and Graham in San Jose took place on Wednesday, November 20, 1991 and involved several different parties. An equipment company was contracted to provide a water truck and operator to wet down the work area and minimize dust emissions during grit excavation and the movement of heavy equipment at HPA.

The grit was loaded nearly to capacity into four 2.5-yd$^3$-capacity material bins with closeable lids, two each for the untreated and treated grit. Pacific Environmental, Inc. provided the bins and the trucks and operators to transport the grit to the Reed and Graham asphalt plant. Battelle supplied the truck driver with a driver's packet which included an enlarged map of the route to the plant. The packet also included material safety data sheets for Cu and Pb powder and the results of chemical analyses performed on the sandblasting grit. Battelle staff also discussed any potential hazards associated with the grit and answered questions for the driver. The truck transporting the material bins was a completely enclosed type with a rear door and hydraulic lift gate. Material bins were filled on the lift gate and then pushed into the truck and secured to the walls. A hazardous materials transportation manifest was not required per the R&D variance from DTSC. The driver was provided with a Bill of Lading stating pickup location, description of cargo, and destination.

American Environmental, Inc. was contracted to excavate the grit because this firm had installed the tarpaulins and would be the best qualified to cut the tarpaulins and then repair them afterwards. A section of tarpaulin approximately 10 feet by 10 feet was removed from each of the two grit piles. Grit material was excavated and loaded into the material bins with a backhoe. The backhoe had an enclosed cab to protect the operator from fugitive dust. However, a filter cassette sampler was placed on the lapel of the backhoe operator's shirt to assess any exposure to inhalable metals. This sampler was run for the duration of the grit excavation and loading operation. The filter was analyzed for total Pb, Cu, and Cr.

After the grit for the field demonstration had been satisfactorily loaded into the bins and the sampling and monitoring described in Section 5.1 and 5.2 were completed, the tarpaulins were resecured over the grit piles and the seams were heat-sealed to prevent infiltration of rain. The grit was successfully and uneventfully transported to Reed and Graham in San Jose.

## 5.5 Grit Storage at the Asphalt Plant

Upon arrival at the asphalt plant, the material bins containing grit were offloaded and placed in a low traffic area in one corner of the yard. Each bin was labeled with hazardous materials signs which identified the contents as Cu- and Pb-contaminated sand. A 3-inch-wide yellow caution ribbon was installed around the bins to isolate them from any usual plant activity in that area. The bins remained at this location until the screening operation took place. Empty bins were reloaded during the screening operation and stored at this same location until the grit was used in the production of asphaltic concrete on Saturday, November 23, 1991.

## 5.6 Background Air Monitoring at the Asphalt Plant

Several days prior to the screening operation and asphalt production, a background air monitoring test was performed on the premises of the asphalt plant to establish a baseline for fugitive dust emissions and contaminants already present in the ambient air. A portable weather station which indicates wind speed, wind direction, and ambient temperatures was set up to obtain site-specific meteorological conditions.

Three air monitoring and sampling locations were selected, two downwind and one upwind of the screening operation area (Photo 5-1). Each monitoring location was equipped with an optical dust monitoring instrument which reports a time-weighted average of fugitive dust emissions.

One of the downwind monitoring locations was equipped with a filter cassette sampler that collects particulates on the filter, which was chemically analyzed for total Cu, Pb, and Cr. Background air data were collected for approximately 90 minutes. During that time several meteorological data points were also collected regarding wind speed, wind direction, and air temperature. Air monitoring results are recorded in Section 6.1.

## 5.7 Screening Operation at Asphalt Hot Plant

Photo 5-1. Locating air monitoring stations for the pilot-scale screening operation at Reed and Graham Asphalt Co., San Jose, California.

Prior to the screening operation, a meeting was held with the employees that work at the asphalt hot plant and who would be involved in screening and/or asphalt production to discuss the safety aspects of the project. Battelle staff gave a brief history of the project at HPA and discussed health and safety concerns. A copy of the work plan was made available for employees to review. Several questions about personal safety and protective equipment required for handling were discussed.

The screening operation was conducted on Friday, November 22, 1991 starting at about 3:00 pm and continuing for approximately 3 hours. Personnel involved in grit handling wore coveralls, hard hats, gloves, and half-face respirators. The screen was a conveyor-type feed with a feed hopper at one end and a ⅜-inch vibrating screen at the other end. A material bin was chained into the bucket of a front-end loader and emptied into the feed hopper. The empty material bin was then taken to the opposite end of the screen and placed under a shoot through which the screened material would pass. The oversized reject material was vibrated off the top of the screen and collected in the bucket of a front-end loader. Polyethylene tarpaulins were placed on the ground under the entire screening area to contain any grit which spilled. When everything was in place, the feed belt was started and the screening process was begun. The reject was rescreened at least two times to ensure that as much grit as possible passed through the screen. The material that didn't pass through the screen was placed into 55-gallon waste drums, and, after California EPA approval, transported back to HPA and stored inside a Navy warehouse.

Air monitoring for particulates was conducted by Battelle during the screening operation (Photo 5-2). Asphalt plant employees wet down the area with water before any activities took place. Battelle set up three air sampling and monitoring stations, one upwind of the screen and two downwind of the screen. Each station was equipped with an optical dust monitoring instrument with a preset audible alarm level of 5 $mg/m^3$ and particulate filters as well. The three filters were analyzed for total Cu, Pb, and Cr. A portable weather station was used to record site-specific meteorological data. A personal monitoring device was worn by the Reed and Graham employee who worked in the area of maximum fugitive dust emissions.

Winds during the screening process were very slight. Samplers were turned on approximately 15 minutes prior to the start of the screening. Hydrogen sulfide monitoring also was performed while screening the treated grit.

## 5.8 Asphalt Production at the Asphalt Plant

The field demonstration was conducted on Saturday, November 23, 1991. The asphaltic concrete containing sandblasting grit was produced at the Reed and Graham asphalt plant starting around 8:00 am Saturday morning, ending approximately 12:30 pm (see Photo 5-3). Ms. Jessie Schnell of California EPA, DTSC, observed the activities at the asphalt plant. After each batch was produced, the asphaltic concrete was transported immediately to HPA for paving. The elapsed time between production and paving was critical because the asphaltic concrete needs to be approximately 250°F or hotter for effective paving. The paving operation is described in Section 5.9.

Three different batches of asphaltic concrete test material were produced:

- A control batch, containing only normal graded aggregate and no sandblasting grit,
- Asphaltic concrete containing untreated sandblasting grit from HPA, and
- Asphaltic concrete containing sulfide-treated sandblasting grit from HPA.

The order of the production of the three batches was first control (at about 8:30 am), followed by untreated grit (at about 10:30 am), followed by treated grit (at about noon). The actual batching process required only 10 to 15 minutes per batch.

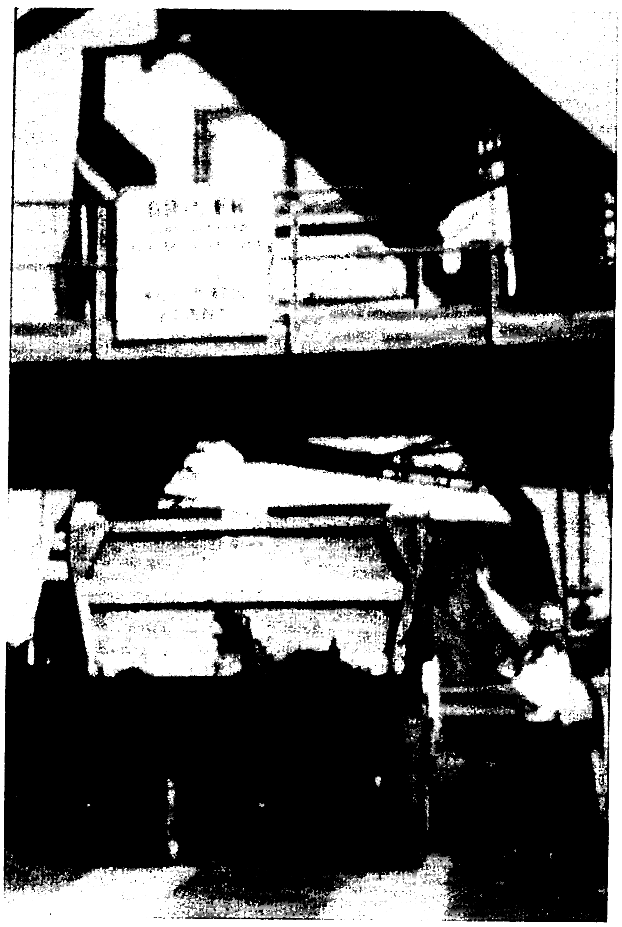


**Photo 5-2. Air monitoring for sulfide emissions.**

Approximately 30 tons of test asphaltic concrete was prepared per batch, shipped to HPA in two 15-ton-capacity end-dump trucks. After the two trucks were loaded (see Photo 5-4), the load was covered with a tarpaulin prior to transport. The asphalt plant was then emptied of any excess material remaining in the mixer, approximately 10 tons of excess material per batch. The excess material containing sandblasting grit was placed in two piles in an isolated part of the plant yard, and was sampled for chemical analysis of total and WET-soluble metals to determine if the grit could be crushed and recycled back into aggregate in a future paving application. The decision on how to dispose of this excess material was made in consultation with California EPA (see Section 6.5).

Approximately 1.5 tons of sandblasting grit was incorporated into each of the two 30-ton batches of test asphalt, therefore corresponding to an average grit concentration of approximately 5% by weight. The concentration was actually slightly less than 5% because some of the grit was incorporated into the 10 tons of excess asphalt heel in the mixer as noted above. An average grit loading of 7% by weight was the target value; however, it proved difficult to accurately achieve this value during these short production runs,

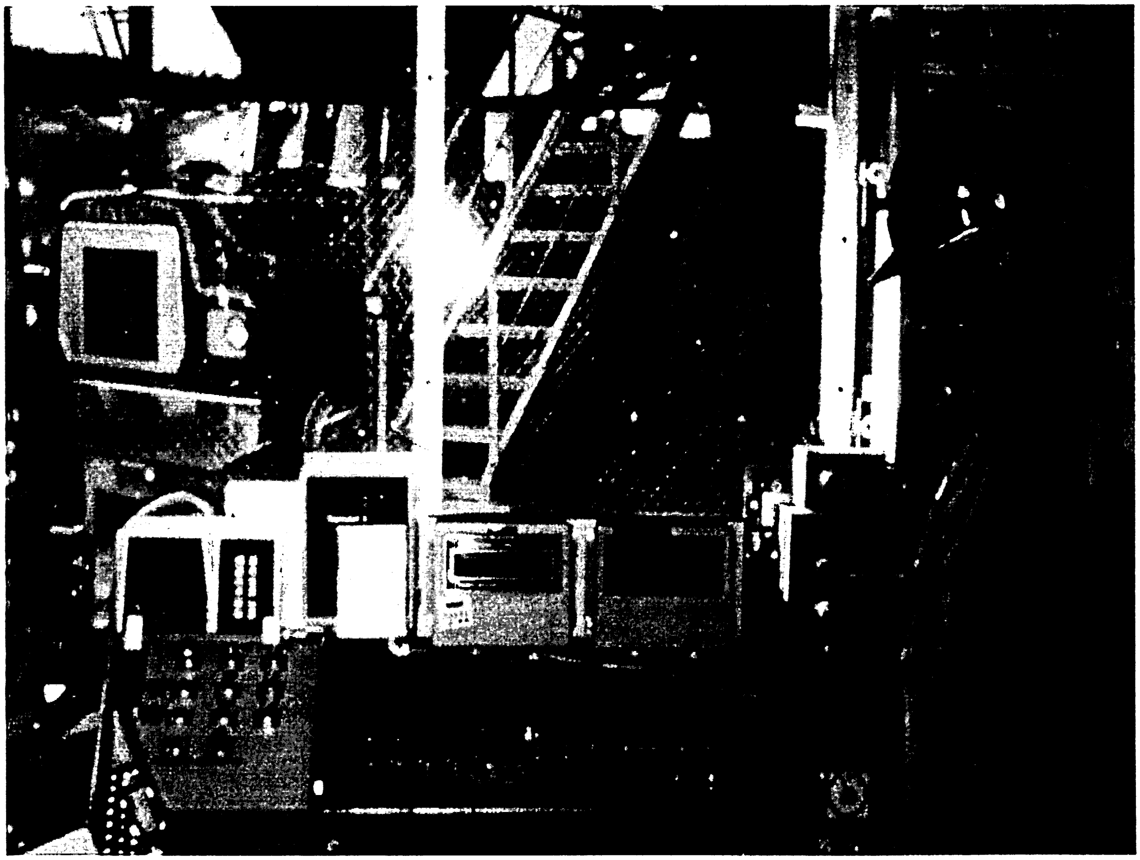


**Photo 5-3. Asphalt production at Reed and Graham Asphalt Co., San Jose, California during the pilot-scale demonstration.**

because the asphalt plant would normally produce hundreds of tons of asphalt per hour. During a longer production run or during normal full-scale processing, accurate grit metering into the asphaltic concrete would not be difficult to achieve after an initial calibration period.

Other process information is as follows:

- 5.3% target oil or bitumen content,
- Normal 3/8″ - graded aggregate mixture (apart from the added sandblasting grit), and
- The target production temperature of 300°F, somewhat higher than normal to ensure adequate temperatures after the 1½-hour commute to HPA for paving.

Each batch of asphaltic concrete was sampled by collecting approximately 5 gallons of loose asphalt material at the hot plant immediately after production. The loose material was later pressed into test pellets and cores under simulated paving compaction conditions, for chemical and physical properties measurements. Results are reported in Section 6.2.

Also, air monitoring for total fugitive dust using an optical dust monitoring instrument and for hydrogen sulfide was conducted during asphalt production. Hydrogen sulfide was monitored

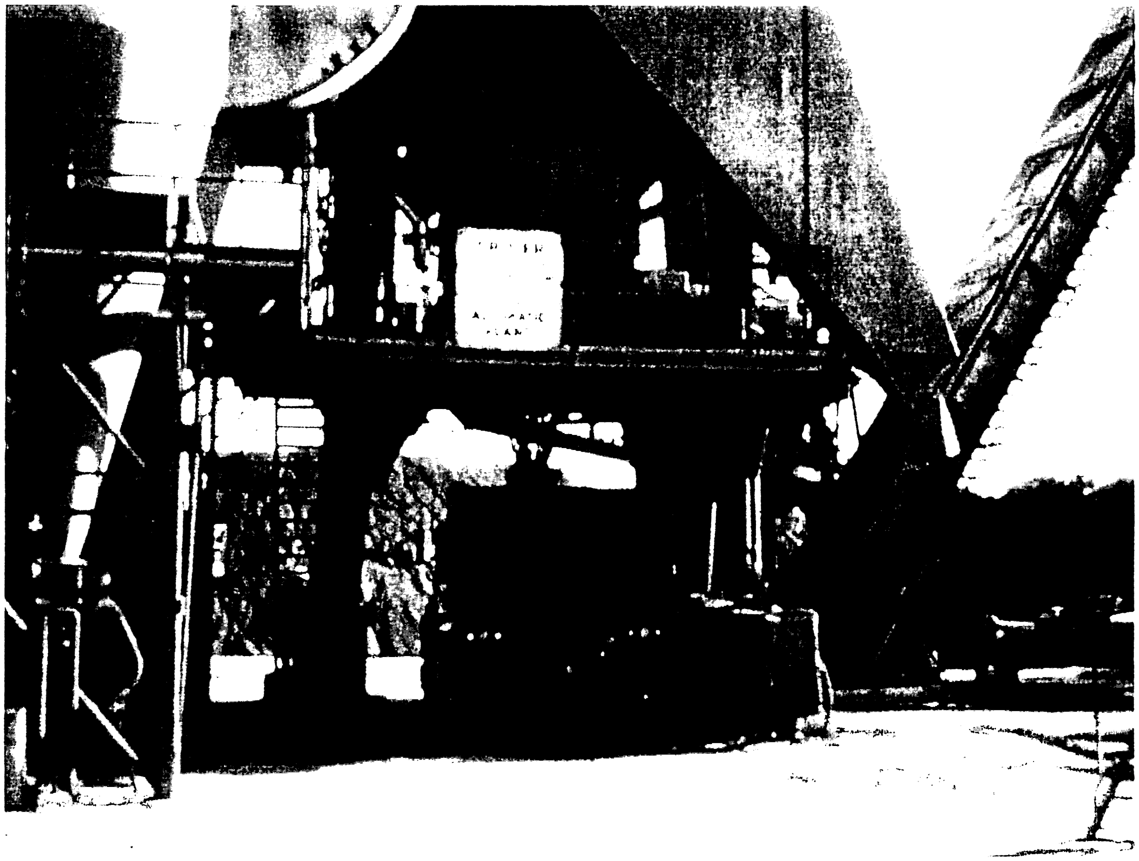


**Photo 5-4. Loading hot asphalt into trucks for transport to the site.**

continuously at ground level by two different individuals during the processing of the sulfide-treated grit. At no time was there any hydrogen sulfide detected at the hot plant. The results of the fugitive dust monitoring are reported in Section 6.1.

A 30-ton batch of asphaltic concrete will provide sufficient material to pave approximately 2,400 square feet of roadway at an average thickness of 2 inches. Each batch produced for this demonstration was used to pave two different test strips at HPA, one larger strip for long-term monitoring and one smaller strip for a roadgrinding air emissions test (see Section 6.4).

## 5.9 Roadway Application of the Asphalt Test Strips

### 5.9.1 Introduction

The asphaltic concrete test material was successfully transported to HPA without incident and was applied to six different test strips at HPA, as follows:

- Two strips containing standard production (control) asphaltic concrete,
- Two strips containing untreated sandblasting grit, and
- Two strips containing sulfide-treated sandblasting grit.

Asphaltic concrete was applied to two different stretches of road at HPA (see Photo 5-5). The field activities and measurements made during placement of the test strips are documented in Appendix I. Three of the six test strips (one each of the asphaltic concrete control, untreated grit, and sulfide-treated grit) were laid for long-term physical and chemical testing. These strips were laid side-by-side extending the width of the road, and measure approximately 30 feet by 50 feet in area by 2 inches deep. Their location is on the south end of Fisher Avenue (Figure 5-1), close to the intersection of Spear Avenue. These test strips were sampled for physical and chemical properties measurements several days after application and will be resampled at approximate intervals of 6 months for the next several years.

The second series of three test strips was laid on Spear Avenue (Figure 5-1), near Building 302, just southwest of the intersection with Fisher Avenue. Each of these strips was laid in series on the northern side of the road and measures approximately 18 feet wide by 50 feet long by 2 to 2.5 inches deep. After approximately 6 months, a roadgrinding operation on these strips is planned to measure the release of fugitive dust and contaminants (see Section 6.4).

**Photo 5-5. Laying the asphalt test strips for the roadgrinding test at Hunters Point Annex.**

### 5.9.2 Surface Preparation

Each test plot was prepared for application in the same manner as normal roads. The crew supervisor inspected each test plot for any failures that might exist and removed vegetation and dirt from the road surface where the test strips were to be installed.

Traffic control barricades were set up to block off the test areas from local traffic, and the fire department and security at HPA were notified. A tack coat was applied to the test areas to ensure a bond between the old pavement and the asphaltic concrete overlay. An SS-1H asphaltic emulsion was applied at a rate of 0.10 gallon per square yard. Subgrade pavement surface temperatures were measured to ensure that the existing pavement was not too cool to pave. The subgrade pavement surface temperatures ranged between 55 and 57°F, which is acceptable.

### 5.9.3 Asphalt Application

Approximately 40 minutes after the tack coat application, the first two trucks from the asphalt plant arrived at HPA. The trucks contained the standard production (control) asphaltic concrete normally produced by the plant. The field engineer recorded temperatures of the asphaltic concrete at 303°F in the first truck and 315°F in the second truck.

The first truck emptied its load into an automatic screen with a spread of 10 feet in width. The screen then began to apply asphalt to the long-term control pilot-scale test strip. Asphalt temperatures were measured during the initial lay and ranged from 247°F to 260°F. After the asphalt had been applied to the long-term test strip, the screen moved down to the roadgrinding operation test strip while a steel-wheeled roller began to compact the freshly laid asphalt. Breakdown rolling compacted the grit/asphalt to obtain the needed density. Then intermediate rolling was conducted to seal and densify the surface. The finish rolling provided a smooth road surface. Densities were checked using a nuclear densitometer which showed 95% compaction on the long-term control test strip. Once the roller had finished on the long-term strip, the operator moved to the roadgrinding control test strip and repeated the rolling operation there.

The first truck of asphaltic concrete containing untreated grit arrived shortly after noon at HPA. The second truck arrived soon thereafter. The first truck offloaded into the hopper of the automatic spreader, and the temperature of the asphaltic concrete was recorded at 296°F. The spreader began laying the untreated grit asphalt on the long-term test strip at Fisher Avenue and was immediately followed by the roller. After the spreader completed its application of asphaltic concrete to the long-term strip, it immediately moved to the Spear Avenue grinding strip area and began application there. Rolling continued at the long-term test strip. The field engineer followed the roller and recorded temperature data at several points, ranging from 260°F to 270°F, on the long-term test strip. As soon as the roller operator was finished rolling the untreated test strip he moved to the roadgrinding operation strip to roll the material which had just been applied by the spreader. The nuclear densitometer measured percent compaction of 95 to 96% on the long-term test strip.

The asphaltic concrete containing sulfide-treated grit arrived at HPA at 14:10 hours. The temperature of the asphaltic concrete taken from the spreader hopper was recorded at 303°F. Temperatures of the treated grit asphalt after rolling ranged from 260° to 270°F. As soon as the long-term test strip was completed, the roller moved to the roadgrinding area and began rolling the treated test strip. The test strips were inspected by the field engineer for smoothness and uniformity.

After all rolling was completed, fog seal was applied to all the test strips. All asphalt application activities were performed by Reed and Graham, Inc. and their contractors (see Photo 5-6).

### 5.10 Sampling and Laboratory Analysis of Asphaltic Concrete Test Specimens

In addition to the loose asphaltic concrete samples described in Section 5.8, asphalt core samples were collected from the long-term test strips several days after the asphaltic concrete was applied. Five undisturbed core samples were collected (five cores of each control, untreated, and sulfide-treated) from each long-term test strip in November 1991. A portable drilling machine along with a water-cooled diamond-tipped coring bit was used for core collection (see Photo 5-7). Core samples were collected in June 1993 and June 1994 to allow testing of long-term performance (see Sections 6.2 and 6.3).

The asphaltic concrete test samples were analyzed for the following physical and chemical parameters in order to assess compliance with Caltrans and DTSC sandblasting grit recycling criteria:

- Stabilimeter value
- Cohesiometer value
- Percent voids

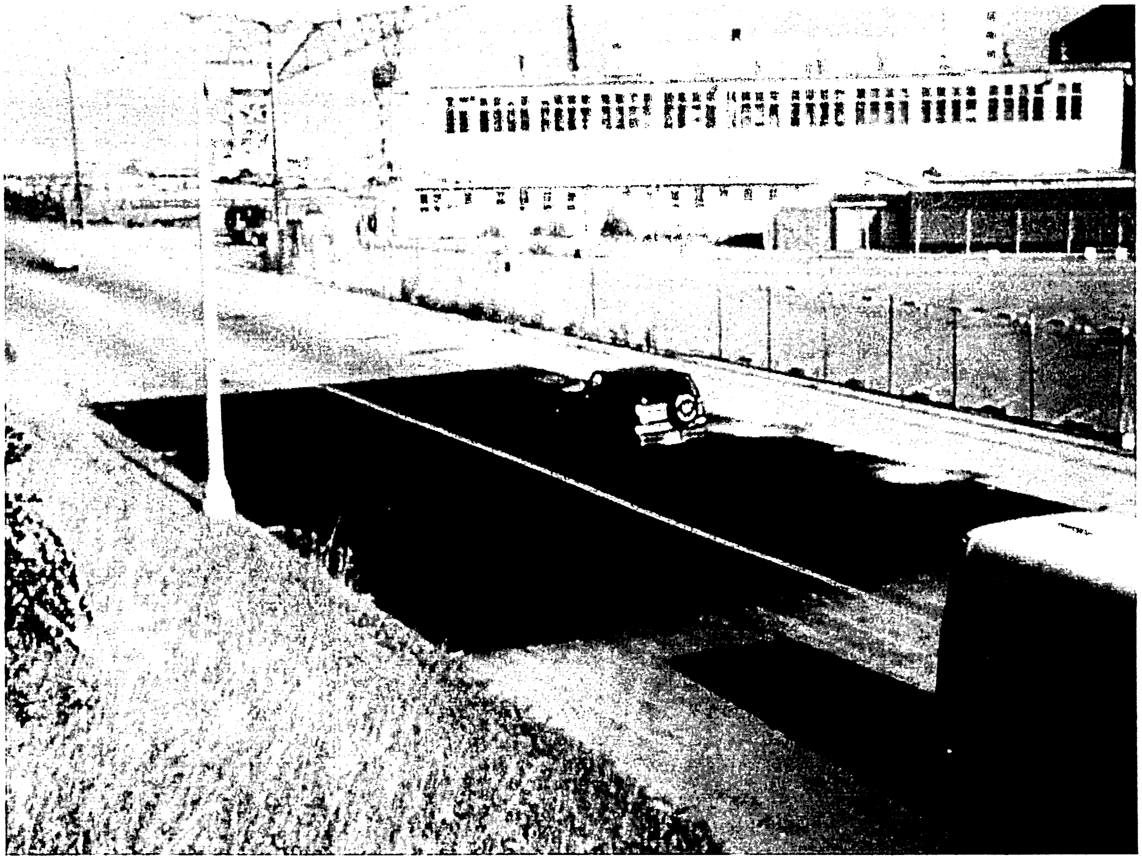


**Photo 5-6. Long-term test strip installed at Hunters Point Annex.**

- WET-soluble Cu and Pb
- Total Cu and Pb

All analyses were conducted by a California-certified laboratory. Results are discussed in Section 6.0.

**Photo 5-7. Coring the long-term test strips to collect samples for chemical and physical testing.**

# 6.0 PERFORMANCE TESTING OF PILOT-SCALE TEST STRIPS

The section discusses the results of (1) the air monitoring activities that were conducted during different phases during the pilot-scale test, (2) the chemical and physical testing analyses conducted on the three different test strips, (3) the regulatory compliance implications of the test results, (4) the methods used and results obtained in the roadgrinding test, and (5) analysis results from the excess asphalt remaining at Reed and Graham. Testing demonstrated that test strips did not degrade in leaching resistance or physical performance as a result of exposure to normal weather and traffic conditions. Compliance with regulatory requirements is discussed in Section 6.3. The roadgrinding test demonstrated that normal road repair activities on recycled grit paving would not generate excessive airborne contaminant levels. The roadgrinding test is described in Section 6.4.

## 6.1 Air Monitoring Results During Pilot-Scale Asphalt Production

During the pilot-scale field test at the asphalt hot plant from November 19 through November 23, 1991, a series of air monitoring tests were conducted. The tests were designed to assess the potential health impacts of dust generated by various activities associated with the production of the grit-containing asphalt. Tests were included to measure the background levels of windborne dust plus ambient concentrations of Cr, Cu, and Pb. These levels were compared to the concentrations from the process being monitored. Personal samplers were included to assess any potential for worker exposure for equipment operators. A portable meteorological monitoring instrument was used to collect site-specific wind speed and direction during the tests.

A summary of the results is included in Table 6-1. The table includes (1) meteorological conditions as recorded on 2 days of ambient sampling; (2) ambient concentrations of Cr, Cu, and Pb as collected on filter samples both upwind and downwind at various distances and in one case an increased height above ground; (3) results of total dust concentrations as measured with an optical dust monitoring instrument; (4) results of the filter cassette analyses in the cab of the backhoe operator during excavation and loading of the sandblasting grit at HPA; and (5) dust concentration monitoring for one worker during the screening operation and two workers during asphaltic concrete production.

The total dust concentrations were very low at both upwind and downwind locations. It should be noted that the wind speed was also low during the entire time period. Only the personal samplers showed any significant dust concentrations and these were orders of magnitude below the Occupational Safety and Health Administration (OSHA)-regulated values for worker inert dust exposures.

The results for Pb, Cu, and Cr indicated that Pb, which is an ambient criteria pollutant, was consistently below the detection limits of the sampling method. Therefore, Pb exposure to workers or the surrounding population was insignificant under the conditions as tested.

Cr was detected in all five of the filters analyzed. However, there was no difference between any of the downwind samples and the upwind samples, indicating no increases in the Cr concentrations relative to the ambient air Cr concentrations in that area.

Cu was the only metal that showed an increase in one of the downwind samples relative to the upwind samples. It was unusual that the downwind sampler at a closer distance from the screening process had a significantly lower Cu concentration that the sampler at a greater distance (Table 6-1).

## Table 6-1. Air Monitoring Data

| METEOROLOGICAL CONDITIONS | | |
|---|---|---|
| TEST DATE: | 19 Nov. 1991 | 22 Nov. 1991 |
| AVG. WIND SPEED: | 1.8 mph (0.56 m/s) | 2.5 mph (1.1 m/s) |
| AVG. TEMPERATURE: | 67°F (20°C) | 60°F (16°C) |
| AVG. WIND DIRECTION: | West — 270° | North-Northwest — 330° |

MONITORING/SAMPLER DATA

| Date | Sampler I.D. | Location (relative to to screen) | Distance/ Height (m) (m) | Sample Volume ($m^3$) | Total Dust ($mg/m^3$) | Chromium ($mg/m^3$) | Copper ($mg/m^3$) | Lead ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|
| Ambient Background Measurements | | | | | | | | |
| 19 Nov. 1991 | 440 BK | downwind | 91 / 2 | 0.18 | — | — | — | — |
| 19 Nov. 1991 | M.R. 4440 | downwind | 91 / 2 | — | 0.00 | — | — | — |
| 19 Nov. 1991 | 442 BK | downwind | 91 / 5 | 0.18 | — | 0.0017 | 0.0011 | <0.011 |
| 19 Nov. 1991 | M.R. 4442 | downwind | 91 / 5 | — | 0.01 | — | — | — |
| 19 Nov. 1991 | 439 BK | upwind | — — | 0.16 | — | — | — | — |
| 19 Nov. 1991 | M.R. 4434 | upwind | — — | — | 0.00 | — | — | — |
| Backhoe Operator During Grit Excavation and Loading at HPA | | | | | | | | |
| 20 Nov. 1991 | HP-1 | backhoe | operator | 0.21 | — | 0.0014 | 0.00095 | <0.0095 |
| Dust Measurements During Grit Screening at Reed and Graham | | | | | | | | |
| 22 Nov. 1991 | SCR-1 | upwind | 21 | 0.26 | — | 0.0016 | <0.00077 | <0.0077 |
| 22 Nov. 1991 | M.R. 4443 | upwind | 21 | — | 0.00 | — | — | — |
| 22 Nov. 1991 | M.R. 4439 | upwind | personal | — | 0.42 | — | — | — |
| 22 Nov. 1991 | SCR-2 | downwind | 38 / 2 | 0.27 | — | 0.0011 | 0.0078 | <0.0074 |
| 22 Nov. 1991 | M.R. 4441 | downwind | 38 / 2 | — | 0.07 | — | — | — |

## Table 6-1. Air Monitoring Data (continued)

| METEOROLOGICAL CONDITIONS | | |
|---|---|---|
| TEST DATE: | 19 Nov. 1991 | 22 Nov. 1991 |
| AVG. WIND SPEED: | 1.8 mph (0.56 m/s) | 2.5 mph (1.1 m/s) |
| AVG. TEMPERATURE: | 67°F (20°C) | 60°F (16°C) |
| AVG. WIND DIRECTION: | West — 270° | North-Northwest — 330° |

**MONITORING/SAMPLER DATA**

| Date | Sampler I.D. | Location (relative to to screen) | Distance/ Height (m) (m) | Sample Volume ($m^3$) | Total Dust ($mg/m^3$) | Chromium ($mg/m^3$) | Copper ($mg/m^3$) | Lead ($mg/m^3$) |
|---|---|---|---|---|---|---|---|---|
| Dust Measurements During Grit Screening at Reed and Graham (Continued) | | | | | | | | |
| 22 Nov. 1991 | M.R. 4442 | downwind | personal | — | 0.00 | — | — | — |
| 22 Nov. 1991 | SCR-3 | downwind | 15 | 0.26 | — | 0.0012 | 0.00077 | <0.0077 |
| 22 Nov. 1991 | M.R. 4438 | downwind | 15 | — | 0.06 | — | — | — |
| 22 Nov. 1991 | M.R. 4440 | downwind | 15 | — | 0.00 | — | — | — |
| Dust Monitors on Workers During the Production of Asphalt at Reed and Graham | | | | | | | | |
| 23 Nov. 1991 | M.R. 4441 | hot plant | personal | — | 0.11 | — | — | — |
| 23 Nov. 1991 | M.R. 4443 | hot plant | personal | — | 0.01 | — | — | — |
| Average (all) | — | — | — | — | 0.06 | 0.0014 | 0.0023 | — |
| (s.d.) | — | — | — | — | (0.12) | (0.0003) | (0.003) | — |

However, there was no exceedance of the OSHA workplace level for Cu exposure in any of the samplers, including the personal sampler.

## 6.2 Results of Long-Term Testing of Chemical and Physical Performance of Pilot-Scale Test Strips

Chemical and physical tests were performed on the asphaltic concrete test specimens to determine compliance with California EPA "Use Constituting Disposal" policy criteria. A traffic count indicated that the traffic density on the inbound lane of the long-term test pavement was about 8 cars per hour. The results of these tests are provided below.

### 6.2.1 Long-Term Leaching Resistance of Pilot-Scale Test Strips

The three different types of asphalt were analyzed for total and WET-soluble Cu and Pb content to determine compliance with DTSC recycling criteria and also to calculate the average grit composition of the asphalt production runs containing untreated and treated grit. The analytical data are presented in Table 6-2.

The total metal data in Table 6-2 were evaluated in comparison with the average total metals content of the grit in Section 2, Table 2-4, as an approach to calculating the weight percent of grit that was added to the untreated and treated grit test strips. In Section 5.8 it was indicated that the grit concentration was about 5%, or slightly less based on the fact that approximately 1.5 tons of grit was incorporated into 30 tons or slightly more of asphaltic concrete. The weight percent grit content of the untreated or treated asphalt, A, was calculated from the following dilution calculation:

$$\frac{[X-Y]}{Z} * 100 = A$$

where X = the total Cu or Pb concentration in the asphaltic concrete test specimen (pellet or core, untreated or treated) from Table 6-2.

Y = the total Cu and Pb concentration in the control asphaltic concrete test specimen (pellet or core, untreated or treated) from Table 6-2.

Z = the mean total Cu or Pb concentration in the untreated or treated grit from Section 2, Table 2-4.

The results of these dilution calculations are provided in Table 6-3, and show that the average grit concentration in the untreated asphaltic concrete was 4.5 $\pm$ 1.6 weight percent and in the treated asphaltic concrete was 5.0 $\pm$ 1.4 weight percent. These values provide independent confirmation of the values estimated from the mass loading of sandblasting grit with the other asphaltic concrete ingredients.

The pilot-scale test strips placed on the south end of Fisher Avenue (Figure 5-1) in November 1991 remained in service. Three core samples were collected from each of the three test strips (untreated, sulfide-treated, and control) in June 1993. One year later, in June 1994, two additional core samples were cut from each of the three areas. These samples were analyzed for total and WET-soluble copper and lead. Core samples were collected for physical performance testing (see Section 6.2.2). The results for the June 1993 and June 1994 samples are shown in Tables 6-4 and 6-5, respectively.

Table 6-2. **Results of Metals Analyses from Recycled Grit Asphaltic Concrete Pilot Test Strips, November 1991 Sampling**

| Sample ID | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| | Cu | Pb | Cu | Pb |
| Control Asphalt Core | 21 | 3.0 | 0.008 | 0.050 |
| Control Lab Pellet | 16 | 3.0 | 0.034 | 0.050 |
| Untreated Asphalt Core | 93 | 17 | 1.2 | 0.056 |
| Untreated Lab Pellet | 74 | 11 | 0.098 | 0.050 |
| Loose Untreated | 110 | 20 | 1.8 | 0.050 |
| Sulfide-Treated Asphalt Core | 62 | 10 | 0.69 | 0.097 |
| Sulfide-Treated Lab Pellet | 93 | 13 | 0.20 | 0.050 |
| Loose Sulfide-Treated | 76 | 9.8 | 0.42 | 0.07 |

Source: Means et al., 1993b, Table 4-1.

Table 6-3. **Dilution Calculations for Determining Weight Percent Grit Used in Asphaltic Concrete**

| Total Threshold Limit Concentration | | | |
|---|---|---|---|
| **(Y) Laboratory Control Pellet** | **(X) Laboratory Untreated Pellet** | **(Z) Grit Concentration** | **Estimated Percent of Grit in Asphaltic Concrete** |
| Cu 16 mg/kg<br>Pb 3.0 mg/kg | Cu 74 mg/kg<br>Pb 11 mg/kg | 1,832 mg/kg<br>204 mg/kg | 3.2%[a]<br>3.9%[a] |
| **Applied Control Core** | **Applied Untreated Core** | | **Estimated Percent of Grit in Asphaltic Concrete** |
| Cu 21 mg/kg | Cu 93 mg/kg | 1,832 mg/kg | 3.9%[a] |
| Pb 3.0 mg/kg | Pb 17 mg/kg | 204 mg/kg | 6.9%[a] |
| **Laboratory Control Pellet** | **Laboratory Sulfide-Treated Pellet** | | **Estimated Percent of Grit in Asphaltic Concrete** |
| Cu 16 mg/kg<br>Pb 3.0 mg/kg | Cu 93 mg/kg<br>Pb 13 mg/kg | 1,300 mg/kg<br>160 mg/kg | 5.9%[b]<br>6.3%[b] |
| **Applied Control Core** | **Applied Sulfide-Treated Core** | | **Estimated Percent of Grit in Asphaltic Concrete** |
| Cu 21 mg/kg<br>Pb 3.0 mg/kg | Cu 62 mg/kg<br>Pb 10 mg/kg | 1,300 mg/kg<br>160 mg/kg | 3.2%[b]<br>4.4%[b] |

(a) Mean grit concentration of asphaltic concrete containing untreated grit = 4.5% ±1.6%.
(b) Mean grit concentration of asphaltic concrete containing treated grit = 5.0% ±1.4%.

Table 6-4. Results of Metals Analyses from Recycled Grit Asphaltic Concrete Pilot Test Strips, June 1993 Sampling

| Sample | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| | Cu | Pb | Cu | Pb |
| Untreated #1 | 70 | 18 | 0.69 | 0.14 |
| Untreated #2 | 98 | 19 | 1.3 | 0.088 |
| Untreated #3 | 90 | 22 | 0.21 | 0.23 |
| Sulfide-Treated #1 | 47 | 12 | 0.88 | 0.073 |
| Sulfide-Treated #2 | 85 | 14 | 0.44 | 0.18 |
| Sulfide-Treated #3 | 25 | 11 | 0.49 | 0.068 |
| Control #1 | 14 | 7.6 | 0.046 | 0.069 |
| Control #2 | 17 | 8.8 | 0.067 | 0.073 |
| Control #3 | 14 | 6.3 | 0.19 | 0.097 |

Source: Means et al., 1993b, Table 2-7.

Table 6-5. Results of Metals Analyses for Recycled Grit Asphaltic Concrete Pilot Test Strips, June 1994 Sampling[(a)]

| Sample | Total (mg/kg) | | | | WET-Soluble (mg/L) | | | |
|---|---|---|---|---|---|---|---|---|
| | Cu | | Pb | | Cu | | Pb | |
| Untreated #1 | 51 | 55 | 9.3 | 9.4 | <0.2 | 0.079 | <0.5 | 0.059 |
| Untreated #2 | 70 | 68 | 15 | 9.5 | 0.51 | 0.012 | <0.5 | 0.069 |
| Sulfide-Treated #1 | 36 | 50 | 10 | 12 | <0.2 | <0.01 | <0.5 | 0.084 |
| Sulfide-Treated #2 | 39 | 55 | 8.8 | 10 | <0.2 | <0.01 | <0.5 | 0.072 |
| Control #1 | 13 | 18 | 8.0 | 5.5 | <0.2 | <0.01 | <0.5 | <0.05 |
| Control #2 | 13 | 29 | 4.8 | 4.7 | <0.2 | <0.01 | <0.5 | <0.05 |

(a) Left-hand column for each metal is inductively coupled plasma (ICP) analysis (Anlab, 8/94); right-hand column for each metal is graphite furnace analysis (Pace Mid-Pacific, 8/94).

### 6.2.2 Long-Term Physical Performance Testing of Pilot-Scale Test Strips

Physical properties measurements were obtained to determine compliance of the grit-containing asphaltic concrete with Caltrans standards. The physical properties test used was the ASTM D1560-81 (Hveem Method). Data collected from the Hveem Method include (1) bitumen or asphalt content, (2) stabilimeter value, (3) cohesiometer value, (4) test temperature, (5) density of asphalt-treated grit mixture, and (6) air voids ratio. The Hveem tests are described in Section 4.2.2.

Samples of asphalt were collected during manufacture of the control, untreated grit, and sulfite-treated grit asphalt for the pilot-scale test strip preparation in November 1991. One core sample was taken from each of the three long-term test strips shortly after the strips were laid.

Results for the physical tests for standard asphaltic concrete (control), asphaltic concrete containing untreated grit, and asphaltic concrete containing treated grit are presented in Table 6-6. A decrease in stabilimeter value was observed for the untreated and sulfide-treated field cores. These samples failed the minimum criteria for stabilimeter values for medium-traffic conditions; however, the laboratory-manufactured cores made from the same asphalt mixture meet the stabilimeter value criteria. The oil content in the field cores was observed to be higher than the oil content in the lab cores. The higher oil content in the field cores is believed to be caused from the tack coat and fog seal that were applied before and after asphalt application. Higher oil contents in test specimens will cause stabilimeter values to be lower. These oils will volatilize with time and the stabilimeter values for the untreated and sulfide-treated field cores are expected to increase and meet Caltrans specifications. This hypothesis was tested by collecting samples later to allow repetition of physical and chemical analysis. Cohesiometer values and swell tests results for all the samples submitted exceeded the minimum test limit criteria. The percent voids values were lower than normally encountered, likely because of the high temperatures upon arrival at HPA and the prompt and thorough compaction through rolling. Such low percent voids values typically are associated with very-high-integrity asphalt and would not be viewed negatively but are not always achieved in the commercial paving industry because there is usually a greater extent of cooling between asphalt production and compaction.

The long-term performance of asphaltic concrete made using spent sandblasting grit as a portion of the aggregate was determined by taking and testing additional core samples. Three core samples were collected from each of the test areas in June of 1993. Two more core samples were collected from each of the test areas in June of 1994. Cores also were collected for chemical testing (see Section 6.2.1). The test results from the long-term core samples from June 1993 and June 1994 are shown in Tables 6-7 and 6-8, respectively.

## 6.3 Compliance with California STLC and Physical Performance Criteria

Calculations can be performed to determine compliance of the asphalt with California STLC requirements after subtracting the background contribution and correcting for the effect of dilution. Table 6-9 presents the results of the calculations for Pb in asphalt strips containing untreated grit. The average WET (leachable) Pb content of the untreated grit was 19 mg/L, compared to an STLC of 5 mg/L. Therefore, the asphalt binder ingredients would need to immobilize the Pb by a factor of approximately four to bring the WET Pb content of the spent sandblasting grit in the asphaltic concrete to below 5 mg/L. Based on analysis of the core samples, the average WET Pb content of the sandblasting grit-containing asphaltic concrete was 0.13 mg/L, versus 0.07 mg/L for control asphalt specimens containing the same aggregate and oil contents, but no sandblasting grit, thus indicating a WET Pb content of 0.06 mg/L attributable of the sandblasting grit component of the asphalt. The grit content of the asphaltic concrete was 5.0%, indicating a dilution factor of 20 which, when multiplied by the background-corrected WET Pb content of the asphaltic concrete, yields 1.2 mg/L Pb. This value is well below the STLC criterion for Pb, 5 mg/L, thus indicating compliance with the criterion. Tables 6-12, 6-13, and 6-14 present similar calculations for Cu and Pb for asphaltic concrete samples containing both treated and untreated grit. In all cases, the STLC criteria have been met. The results for the June 1994 sampling are not included in this example calculation because the majority of the

**Table 6-6. Recycled Grit Asphaltic Concrete Physical Performance Tests, November 1991 Pilot Test Sampling**

| Test Performed | Lab Control | Control Field Core | Lab Untreated | Untreated Field Core | Lab Sulfide-Treated | Sulfide-Treated Field Core | Acceptance Criteria |
|---|---|---|---|---|---|---|---|
| Percent Oil by Weight of Aggregate (%) | 5.4 | 5.4 | 5.3 | 6.2 | 4.9 | 5.7 | |
| Percent Oil by Weight of Mix (%) | 5.2 | 5.1 | 5.0 | 5.8 | 4.7 | 5.4 | |
| Maximum Theoretical Unit Weight (ASTM D-2041) (PCF) | 153.8 | 154.3 | 154.6 | 153.3 | 155.0 | 154.2 | |
| Laboratory-Compacted Unit Weight (PCF) | 150.8 | 149.6 | 150.7 | 150.5 | 150.6 | 151.3 | |
| Percent Voids (%) | 1.9 | 3.0 | 2.6 | 1.9 | 2.9 | 1.9 | 4 (min)(-)8 (max)[(a)] |
| Hveem Stabilimeter Value | 36 | 41 | 39 | 27 | 37 | 29 | 35 (min)[(b)] |
| Compacted Appearance of Hveem Specimens | flushing | slt. flushing | flushing | flushing | flushing | flushing | |
| Swell (CA 305) (in) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.030 in (max) |
| Cohesiometer (CA 306) | 430 | 494 | 406 | 420 | 476 | 425 | 50 (min)[(c)] |

(a) Asphalt Institute (1962) criteria; minimum value for Hveem test, maximum value as listed for Marshall test. Note that there is no maximum % voids value for the Hveem test in the Asphalt Institute (1962) criteria.
(b) Caltrans criterion for medium-traffic applications.
(c) Asphalt Institute (1962) criteria.
PCF = pounds per cubic foot.

## Table 6-7. Recycled Grit Asphaltic Concrete Tests, June 1993 Pilot Test Sampling

| Test Performed | Control #1 | Control #2 | Control #3 | Untreated #1 | Untreated #2 | Untreated #3 | Sulfide-Treated #1 | Sulfide-Treated #2 | Sulfide-Treated #3 | Acceptance Criteria |
|---|---|---|---|---|---|---|---|---|---|---|
| Percent Oil by Weight of Aggregate (%) | 5.8 | 6.2 | 6.1 | 5.9 | 5.4 | 6.0 | 6.1 | 6.6 | 6.2 | |
| Percent Oil by Weight of Mix (%) | 5.5 | 5.8 | 5.8 | 5.6 | 5.2 | 5.6 | 5.7 | 6.2 | 5.8 | |
| Maximum Theoretical Unit Weight (ASTM D-2041) (PCF) | 154.5 | 153.7 | 154.6 | 155.0 | 155.6 | 155.2 | 154.7 | 153.7 | 154.1 | |
| Laboratory-Compacted Unit Weight (PCF) | 150.1 | 150.5 | 151.2 | 150.6 | 150.8 | 150.8 | 150.3 | 151.1 | 151.8 | |
| Percent Voids (%) | 2.8 | 2.1 | 2.2 | 2.8 | 3.1 | 2.8 | 2.8 | 1.7 | 1.5 | 4 (min)(-) 8 (max)[a] |
| Hveem Stabilimeter Value | 37 | 22 | 32 | 41 | 35 | 32 | 32 | 21 | 17 | 35 (min)[b] |
| Compacted Appearance of Hveem Specimens | moderate flushing | flushing & pumping | flushing | moderate flushing | very slight flushing | moderate flushing | flushing | flushing & pumping | flushing & pumping | |
| Swell (CA 305) (in) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.030 in (max) |
| Cohesiometer (CA 306) | 542 | 343 | 503 | 505 | 455 | 480 | 405 | 377 | 155 | 50 (min)[c] |

(a) Asphalt Institute (1962) criteria; minimum value of Hveem test, maximum value as listed for Marshall Test. Note that there is no maximum percent voids value for the Hveem test in the Asphalt Institute (1962) criteria.
(b) Caltrans criterion for medium-traffic applications.
(c) Asphalt Institute (1962) criteria.
PCF = pounds per cubic foot.
Source: Means et al., 1993b, Table 2-9.

**Table 6-8. Recycled Grit Asphaltic Concrete Physical Performance Tests, June 1994 Pilot Test Sampling**

| Test Performed | Control #1 | Control #2 | Untreated #1 | Untreated #2 | Sulfide-Treated #1 | Sulfide-Treated #2 | Acceptance Criteria |
|---|---|---|---|---|---|---|---|
| Percent Oil by Weight of Aggregate (%) | 5.4 | 6.1 | 5.1 | 5.9 | 5.5 | 5.3 | |
| Percent Oil by Weight of Mix (%) | 5.2 | 5.8 | 49 | 5.6 | 5.2 | 5.0 | |
| Maximum Theoretical Unit Weight (ASTM D-2041) (PCF) | 155.7 | 153.8 | 155.6 | 154.9 | 155.9 | 155.3 | |
| Laboratory-Compacted Unit Weight (PCF) | 149.0 | 151.1 | 150.9 | 149.2 | 151.9 | 150.2 | |
| Percent Voids (%) | 4.3 | 1.8 | 3.0 | 3.7 | 2.5 | 3.3 | 4 (min)(-)8 (max)[(a)] |
| Hveem Stabilimeter Value | 41 | 28 | 40 | 45 | 40 | 45 | 35 (min)[(b)] |
| Compacted Appearance of Hveem Specimens | stable | flushing & pumping | slight flushing | stable | flushing | slight flushing | |
| Swell (CA 305) (in) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.030 in (max) |
| Cohesiometer (CA 306) | 402 | 220 | 331 | 460 | 487 | 495 | 50 (min)[(c)] |

(a) Asphalt Institute (1962) criteria; minimum value for Hveem test, maximum value as listed for Marshall test. Note that there is no maximum percent voids value for the Hveem test in the Asphalt Institute (1962) criteria.
(b) Caltrans criterion for medium-traffic applications.
(c) Asphalt Institute (1962) criteria.
PCF = pounds per cubic foot.

**Table 6-9. Calculations for Pb in Asphaltic Concrete Test Strips Containing Untreated Grit**

| | |
|---|---|
| Mean Total Pb Content of Grit | 204 mg/kg |
| Mean WET Pb Content of Grit | 19 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.13 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 to 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A−B) | 0.06 mg/L |
| D) Dilution Factor — Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C × D) | 1.2 mg/L |
| F) STLC for Pb | 5.0 mg/L |

**Table 6-10. Calculations for Cu in Asphaltic Concrete Test Strips Containing Untreated Grit**

| | |
|---|---|
| Mean Total Cu Content of Grit | 1,832 mg/kg |
| Mean WET Cu Content of Grit | 144 mg/L |
| A) WET Cu Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.85 mg/L |
| B) WET Cu Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 to 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Cu Content of Asphalt Test Strips (A−B) | 0.75 mg/L |
| D) Dilution Factor — Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Cu Content of Asphalt Test Strips (C × D) | 15 mg/L |
| F) STLC for Cu | 25 mg/L |

analyses indicated leachable Cu and Pb concentrations below the detection limit. The results for June 1994 showed no significant change in total metal content and a possible reduction in copper and lead leachability. The decrease in metal leachability may be due to slow changes in the physico-chemical form of the metals, i.e., gradual immobilization of Cu and Pb in the asphalt matrix.

The long-term pilot-scale testing indicates that the use of the sandblasting grit in asphalt paving is a viable option under the California waste management memo (Appendix C). The sand-blasting grit provides value as aggregate in the asphalt while the asphalt assists in immobilizing metal contaminants.

**Table 6-11. Calculations for Pb in Asphaltic Concrete Test Strips Containing Sulfide-Treated Grit**

| | |
|---|---|
| Mean Total Pb Content of Grit | 160 mg/kg |
| Mean WET Pb Content of Grit | 11.1 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 to 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A−B) | 0.03 mg/L |
| D) Dilution Factor — Untreated Test Strips | 22 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C × D) | 0.66 mg/L |
| F) STLC for Pb | 5.0 mg/L |

**Table 6-12. Calculations for Cu in Asphaltic Concrete Test Strips Containing Sulfide-Treated Grit**

| | |
|---|---|
| Mean Total Cu Content of Grit | 1,300 mg/kg |
| Mean WET Cu Content of Grit | 55.5 mg/L |
| A) WET Cu Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.63 mg/L |
| B) WET Cu Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 to 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Cu Content of Asphalt Test Strips (A−B) | 0.53 mg/L |
| D) Dilution Factor — Untreated Test Strips | 22 |
| E) Dilution-Corrected WET Cu Content of Asphalt Test Strips (C × D) | 11.7 mg/L |
| F) STLC for Cu | 25 mg/L |

Several performance parameters are tabulated as a function of time to allow examination of the effects of weathering on asphaltic concrete made with untreated grit (Table 6-13) and treated grit (Table 6-14). The general trend is as expected showing a slow decrease in percent oil while percent voids and Hveem stabilimeter values increased. Stabilimeter values were within the test limit criteria for asphalt made from both types of grit for all of the June 1994 samples. The percent voids were still low but, as discussed in Section 6.2, the low percent voids is reasonable given the asphalt temperature at the time of placement and is not an indicator of poor quality asphalt. The trend of all physical performance parameters indicates good quality paving showing normal weathering and aging effects.

**Table 6-13. Comparison of Physical Performance Data for Asphaltic Concrete Made with Untreated Grit**

| | Averaged Long-Term Results | | | |
|---|---|---|---|---|
| | November 1991 | June 1993[a] | June 1994[b] | Acceptance Criteria |
| Percent Oil by Weight of Mix (%) | 5.8 | 5.5 | 5.3 | |
| Percent Voids (%) | 1.9 | 2.9 | 3.4 | 4 (min) 8 (max) |
| Hveem Stabilimeter Value | 27 | 36 | 42.5 | 35 (min) |
| Swell (CA 305) (in) | 0.000 | 0.000 | 0.000 | 0.030 (max) |
| Cohesiometer (CA 306) | 420 | 480 | 400 | 50 (min) |

(a) Average of three values (Table 6-7).
(b) Average of two values (Table 6-8).

**Table 6-14. Comparison of Physical Performance Data for Asphaltic Concrete Made with Sulfide-Treated Grit**

| | Averaged Long-Term Results | | | |
|---|---|---|---|---|
| | November 1991 | June 1993[a] | June 1994[b] | Acceptance Criteria |
| Percent Oil by Weight of Mix (%) | 5.4 | 5.9 | 5.2 | |
| Percent Voids (%) | 1.9 | 2.0 | 2.9 | 4 (min) 8 (max) |
| Hveem Stabilimeter Value | 29 | 23 | 43 | 35 (min) |
| Swell (CA 305) (in) | 0.000 | 0.000 | 0.000 | 0.030 (max) |
| Cohesiometer (CA 306) | 425 | 312 | 491 | 50 (min) |

(a) Average of three values (Table 6-7).
(b) Average of two values (Table 6-8).

## 6.4 Roadgrinding Test Activities and Results

Recycling asphaltic concrete paving is a common practice in the United States. In 1992, for example, more than 12,000,000 tons of asphalt was ground and reused for new paving (ARRA, 1994). Asphalt paving recycling requires breaking or grinding the old road surface, an operation that generates dust. Grinding old pavement made from asphalt containing spent sandblasting grit as part of the aggregate raises concerns about possible elevated metal levels in dust generated by the road-grinding operation.

### 6.4.1 Roadgrinding Test Methods

On July 13, 1993, a test was conducted to determine the quantity and metal composition of dust emissions generated from asphaltic concrete paving material during roadgrinding operations. The roadgrinding test indicated that there is no difference in metal contaminant exposures experienced by the grinder operator between the dust generated from the control strips and strips containing the sulfide-treated or untreated grit and, in all cases, the Cu, Cr, and Pb exposures are well below prescribed limits.

Three asphaltic concrete test strips were produced and laid at HPA in November 1991 for subsequent use in the roadgrinding test (see Section 5.9). Two of these strips were produced using each of the two different types of sandblasting grits produced at HPA, i.e., untreated grit and sulfide-treated grit, as part of the aggregate. The third test strip, a control, was produced out of normal aggregate materials used in paving. Figure 6-1 shows the layout of the three 10-ft-wide by 50-ft-long strips on the western edge of Spear Avenue just north of the intersection of Cochrane Street.

On July 19, 1993, the standard roadgrinding operation used to remove old or deteriorating asphaltic concrete prior to repaving was simulated (see Photo 6-1). The simulation involved the following steps:

1. A mechanical planing machine removed the approximately 2-in-thick lifts of test strip material.

2. A sweeping machine collected the debris for recycling to an asphalt plant for use as aggregate in future paving operations.

The simulation was conducted by Anrak Inc. of San Carlos, California, a major Bay-area construction firm.

Aerosol and dust measurements were taken with aerosol collection apparatus during the simulated grinding and sweeping. Measurements in the immediate area of the roadgrinding apparatus and operator as well as at two different points downwind from the operator were taken to determine personal and residential exposure potential. A meteorological station was installed to monitor wind speed and direction (see Photo 6-2). One upwind measurement was taken to establish a baseline. Analyses included total dust by mass and the total Cu, Cr, and Pb contents of the dust. The analytical data were modeled to evaluate the potential occupational and public risk of exposure to grinding asphalt containing low levels of sandblasting grit. Risks to potential receptors were characterized and evaluated in terms of regulatory exposure thresholds.

### 6.4.2 Roadgrinding Test Results

**6.4.2.1 Personal Exposure Monitoring.** Table 6-15 shows the aerosol mass concentrations and metals concentrations measured during the roadgrinding simulation. Measurable dust levels were collected when the roadgrinder operator's breathing zone was monitored. The concentrations of all three metals (Cr, Cu, and Pb) were below detection limits. The total dust concentrations measured with the personal sampler during grinding of the three strips were 6.2, 12.2, and 16.3 mg/m$^3$. These concentrations can be compared to the upwind particulate concentration of 0.2 mg/m$^3$. Variations in the microclimate of the grinder operator during the short sampling periods may have resulted in the substantial short-term variations in exposure levels to dust concentrations. For a longer sampling period, such as an 8-hour shift, these variations would be greatly reduced, eliminating the possibility that these variations were caused by any differences in the asphalts processed.

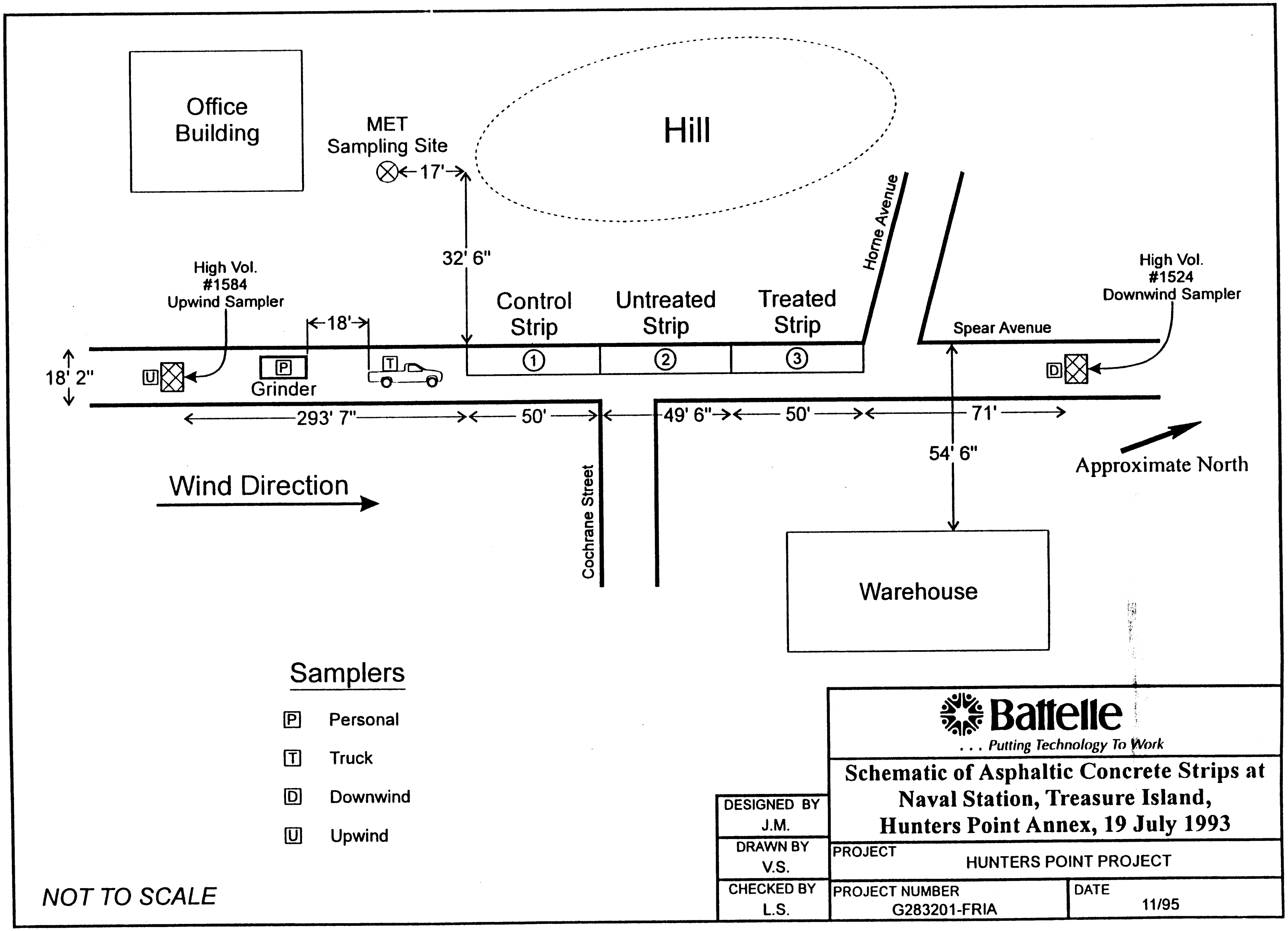



**Figure 6-1. Schematic Map of Asphaltic Concrete Strips at Naval Station, Treasure Island, Hunters Point Annex, 19 July 1993.**

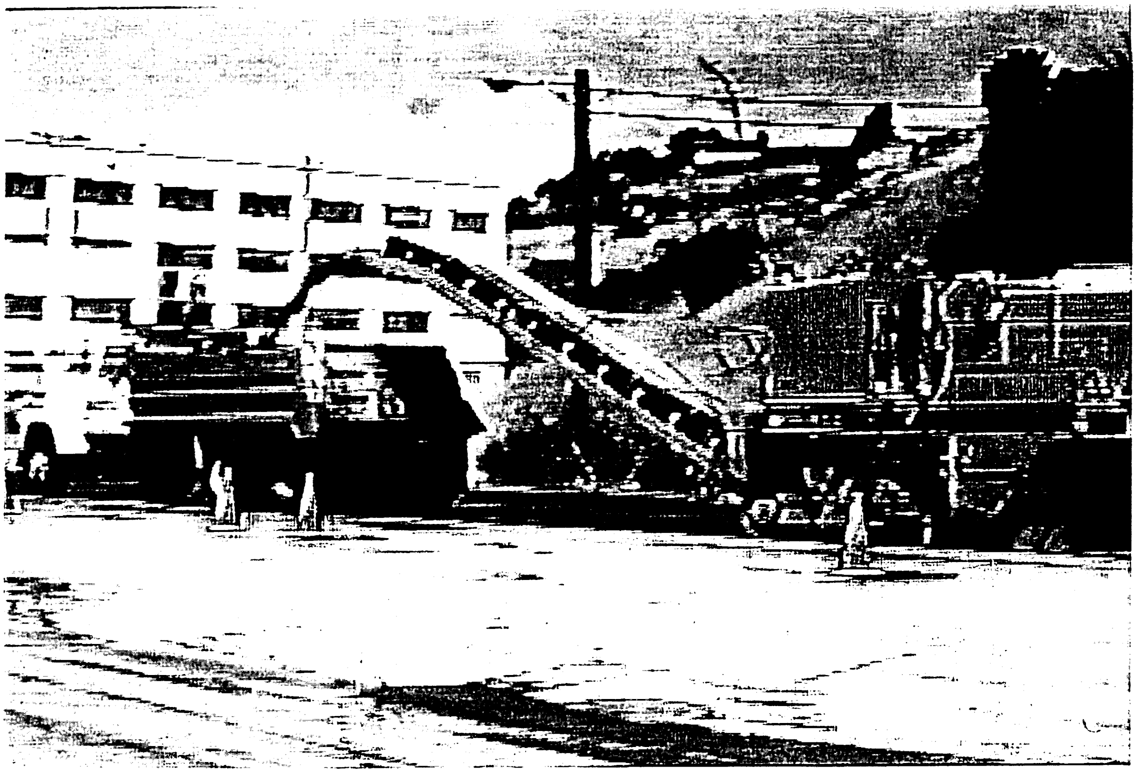


**Photo 6-1. Roadgrinding operations at Hunters Point Annex test strips.**

The total dust concentration values measured would indicate that worker exposure could exceed the threshold limit value (TLV) for dust (10 mg/m$^3$) for any of the test strips processed, if grinding operations were continuous through an 8-hour shift.

Actually exceeding the total dust TLV in normal practice is, however, unlikely due to the following two factors:

1. The sampling was conducted only during the actual grinding operation and cannot be extrapolated to a complete work shift without accounting for the fact that the grinding is intermittent. Intermittent grinding presumably would result in a lower average exposure for the operator during an 8-hour shift.

2. The results presented here are greatly affected by the prevailing wind conditions. The ambient meteorological conditions for this test were not unusual, but extrapolation to exposures under other conditions is not reliable.

Direct measurement of the metal exposure experienced by the roadgrinder operator was not possible. However, it was possible to estimate the concentrations of Cr, Cu, and Pb received by the operator. One can reasonably assume that the metals content of the particles collected by the down-wind high-volume sampler is the same as that for the particles collected by the personal sampler, because both are collecting emissions from the same sources. With that assumption, the average Cr, Cu, and Pb fraction measured on the high-volume samples can be used to estimate the metal concentrations for the personal sampler. The average fractions of the metals in the particle samples

**Photo 6-2. Meteorological monitoring during roadgrinding test at Hunters Point Annex.**

collected on the "truck" and downwind high-volume samplers were Cr = 2.2 E-4, Cu = 1.7 E-4, and Pb = 1.1 E-4. The estimate the metals concentrations from the peroneal sampler, the total dust concentration values were multiplied by these factors. This calculation yields an average exposure level of Cr = 2.5 $\mu g/m^3$, Cu = 2.0 $\mu g/m^3$, and Pb = 1.3 $\mu g/m^3$.

To provide a frame of reference, these exposure values can be compared to the time-weighted average (TWA) exposure limits of 1 $mg/m^3$ for Cr dust and for Cu dust, and 50 $mg/m^3$ for Pb dust. Clearly, the measured exposure values are well below the prescribed limits.

Finally, it should be noted that no difference was detected between the metal exposures received by the grinder operator and the dusts generated from the control asphalt and from the strips containing treated or untreated grit.

**6.4.2.2 Residential Exposure Potential.** The 3-hour average total dust mass concentration upwind of the grinder due to the grinding of the treated strip was approximately the same as that measured downwind of the control and untreated strips. The grinding of the strip made with sulfide-treated grit in the aggregate resulted in a noticeably higher (about 1 order of magnitude) total dust concentration downwind of the grinder. However, the downwind sampler was located much closer to the sulfide-treated grit strip than to either the control strip or the untreated grit strip. The truck samples resulting from all three strips indicate 1.5 $mg/m^3$ of total dust concentration of roughly 6 meters from the source. However, for the control strip, the test operator believes that the truck was not positioned as well for collection of dust emissions as it was for the samples from the other two strips.

**Table 6-15. Aerosol Mass Concentrations and Metals Concentrations Measured During Roadgrinding Operations at Hunters Point Annex, 19 July 1993**

| Asphalt Test Strip | Test # | Filter[a] | Mass (mg) | Total Volume ($m^3$) | Mass Concentration ($mg/m^3$) | Chromium ($\mu g/m^3$) | Copper ($\mu g/m^3$) | Lead ($\mu g/m^3$) |
|---|---|---|---|---|---|---|---|---|
| Control | 1 | T 61 | 20 | 23.8 | 0.8 | 0.304 | 0.096 | 0.062 |
| | 1 | D 62 | 2.4 | 26.9 | 0.1 | 0.062 | 0.060 | 0.027 |
| | 1 | P 21 | 0.305 | 0.0495 | 6.2 | ND[c] | ND[c] | ND[c] |
| Untreated | 2 | T 64 | 33.6 | 22.3 | 1.5 | 0.105 | 0.132 | 0.069 |
| | 2 | D 65 | 7.4 | 20.2 | 0.4 | 0.040 | -0.013 | 0.026 |
| | 2 | P 22 | 0.439 | 0.0269 | 16.3 | ND[c] | ND[c] | ND[c] |
| Sulfide-Treated | 3 | T 67 | 33.5 | 22.3 | 1.5 | 0.102 | 0.132 | 0.105 |
| | 3 | D 66 | 31.4 | 20.2 | 1.6 | 0.126 | 0.179 | 0.222 |
| | 3 | U 63[b] | 37.1 | 188 | 0.2 | 0.011 | 0.048 | 0.052 |
| | 3 | P 23 | 0.437 | 0.0357 | 12.2 | ND[c] | ND[c] | ND[c] |

(a) P = Personal; T = Truck; D = Downwind; U = Upwind.
(b) The upwind filter sampled throughout the three test periods.
(c) All metals below detection limits on all personal filter samples.

Upwind samples were used to indicate the background concentrations of the three metals (Cr, Cu, and Pb) to determine their concentrations resulting from roadgrinding. In all cases, the metal concentrations were so low that the high-volume filter segments had to be resubmitted for analysis to obtain detectable masses. The truck samples indicate a slightly higher chromium level in the control strip, but otherwise there is not much difference in the dust emissions from the three strips.

A model using simple Gaussian plan dispersion was set up to calculate the metals concentrations in areas surrounding the roadgrinding operations. The Gaussian model for a ground-level concentration from a continuous source, which in this case is the roadgrinder, is as follows:

$$\chi(x,y) = \frac{Q}{\pi \sigma_y \sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right]$$

where $\chi$ = concentration, g/m$^3$
$x$ = downwind distance to a receptor, m
$y$ = crosswind distance to a receptor, m
$Q$ = uniform emission rate, g/s
$\sigma_y, \sigma_z$ = horizontal and vertical dispersion coefficients, which are functions of x and atmospheric stability class, m (from Table 6-16)
$u$ = mean wind speed, m/s.

Based on calculations using the Gaussian dispersion equation and concentration measurements from the downwind high-volume sampler, the continuous source used in the model is set conservatively at a constant 1 gram of airborne dust per second.

The Gaussian model can be used to determine the metals concentrations as a function of the downwind distance, x, as well as the crosswind distance, y, of the receptor to the source. Figure 6-2 shows the dust concentrations for a receptor located 50 m downwind from the source for a wind velocity of 5 m/s calculated using the Gaussian model. Note that when the receptor is directly downwind of the source (y = 0), the concentration is highest. Because the source (roadgrinder) is not fixed, but is a likely receptor, the concentration versus distance curve can be used to calculate an average dust exposure in mg/m$^3$. The calculated average is 95% of the total area under the curve divided by the distance y over which this area occurs.

By taking the maximum of each metal's percentage of dust concentration from the truck and downwind samplers for all three strips, and by calculating the average dust exposures for different

**Table 6-16. Calculated Source Strengths for Pasquill Stability Classes B and C**

| Test Strips | Distance (m) | Class B | | $Q_b$ (mg/s) | Class C | | $Q_c$ (mg/s) |
|---|---|---|---|---|---|---|---|
| | | $\sigma_y$ (m) | $\sigma_z$ (m) | | $\sigma_y$ (m) | $\sigma_z$ (m) | |
| Control | 59.8 | 10.2 | 6.6 | 630 | 8 | 4.5 | 340 |
| Untreated | 44.5 | 9 | 4.9 | 1,700 | 6.2 | 3.5 | 850 |
| Sulfide-treated | 29.3 | 6 | 3.3 | 3,200 | 4.3 | 2.4 | 1,700 |

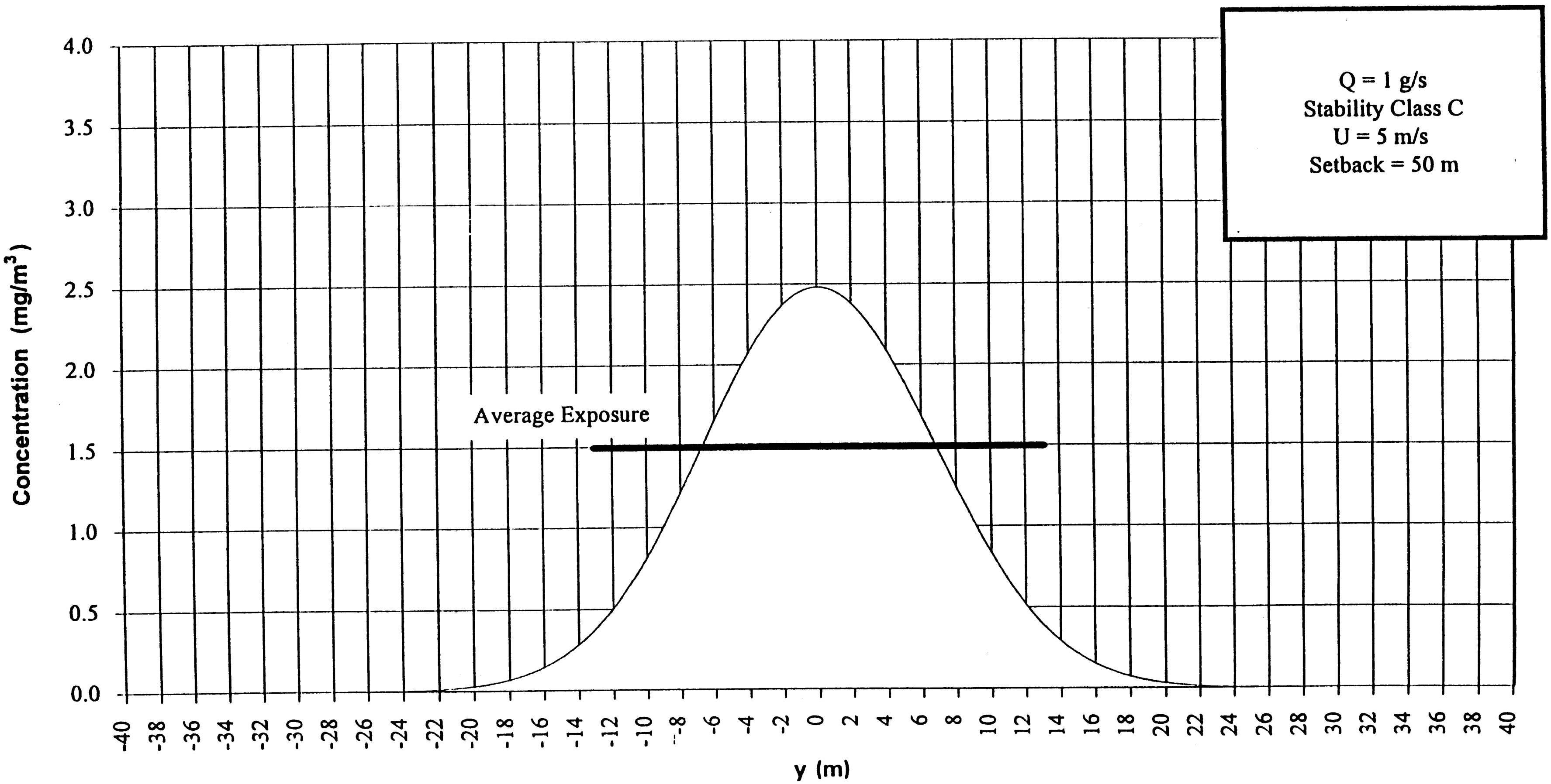



Figure 6-2. Dust Concentrations (mg/m$^3$) for a Receptor Located 50 m Downwind from the Source for a Wind Velocity of 5 m/s.

values of downwind distances, the amounts of metals concentrations may be determined. The maximum percentages of dust concentrations for Cu, Cr, and Pb were experimentally determined to be 0.060%, 0.062%, and 0.027%, respectively. By applying these percentages to the average dust exposures over varying downwind receptor distances, assuming uniform velocities of 2 and 5 m/s, and by calculating the 8-hour TWAs for the concentrations of each of the metals, the graphs shown in Figures 6-3 and 6-4 were produced. It is evident from these figures that the computed average exposures for all three metals fall well below the regulation 8-hour TWA exposures. To display the metals concentrations on a per ton of ground asphalt basis, the graphs were normalized as shown in Figures 6-5 and 6-6. These normalized curves assume a grinder with a width of 10 feet and a lift of 2 inches that has ground a 50-foot strip of asphalt, as was the case in the experiment.

### 6.4.3 Implications of the Roadgrinding Test

In measurements of personal exposure to the roadgrinder operator, the total dust concentrations during grinding of all three of the strips were higher than the upwind particulate concentration of 0.2 mg/m$^3$. The total dust exposure was higher during grinding of the control test strip, but the variation is more likely to be due to wind conditions than to any difference in the asphalts processed. The variations of the microclimate of the grinder operator during the short sampling periods result in substantial short-term variations in exposure levels. For a longer sampling period, such as an 8-hour shift, much less variation would be seen.

The total dust concentration values measured indicate that worker exposure could exceed the TLV for dust (10 mg/m$^3$) during grinding operations for any of the asphalts processed, if the grinding proceeded continuously for a full 8-hour shift. The total dust concentration results cannot be extrapolated to a complete work shift without accounting for the fact that the grinding is intermittent, because the sampling was conducted only during the actual grinding operation (see Photo 6-3). Intermittent operation would result in a lower average exposure for the operator during an 8-hour shift. Furthermore, the results presented here are greatly affected by the prevailing wind conditions. Although the ambient meteorological conditions for this test were not unusual, extrapolation to exposures under other conditions would not be reliable.

There was no difference in the metal exposures experienced by the grinder operator between the dusts generated from the control asphalt and those strips containing the treated or untreated grit, and the estimated concentrations of Cu, Cr, and Pb received by the operator are well below the prescribed limits.

In the measurements and calculations of residential exposure potential, although the 3-hour average total dust mass concentration upwind of the grinder was approximately the same as that measured downwind of the control and untreated strips, the grinding of the treated strip results in a noticeably higher total dust concentration downwind of the grinder. The difference may be attributed in part to the fact that the downwind sampler is much closer to the treated strip than to either the control strip or the untreated strip. As for the truck samples, the truck may not have been positioned as well for collection of dust emissions as it was for the other two strip's samples.

The analytical results of the calculations showed that when the receptor is directly downwind of the source, the concentration is highest. When the curve was modified to give an average dust exposure for a non-fixed source, the computed average exposures for all three metals also fell well below the regulatory 8-hour TWA exposures.

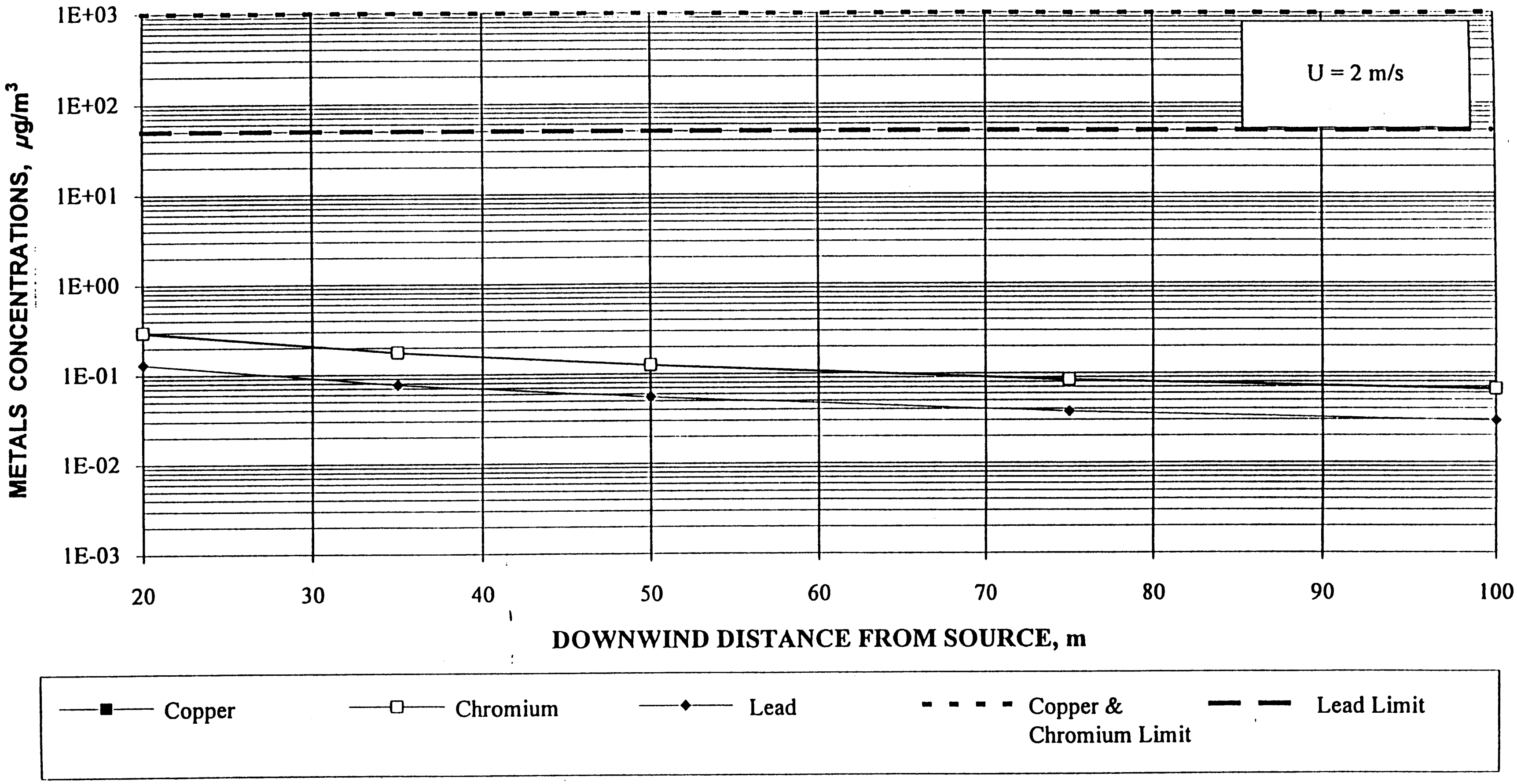



**Figure 6-3. Metals Concentrations ($\mu g/m^3$) Assuming a Uniform Velocity of 2 m/s.**

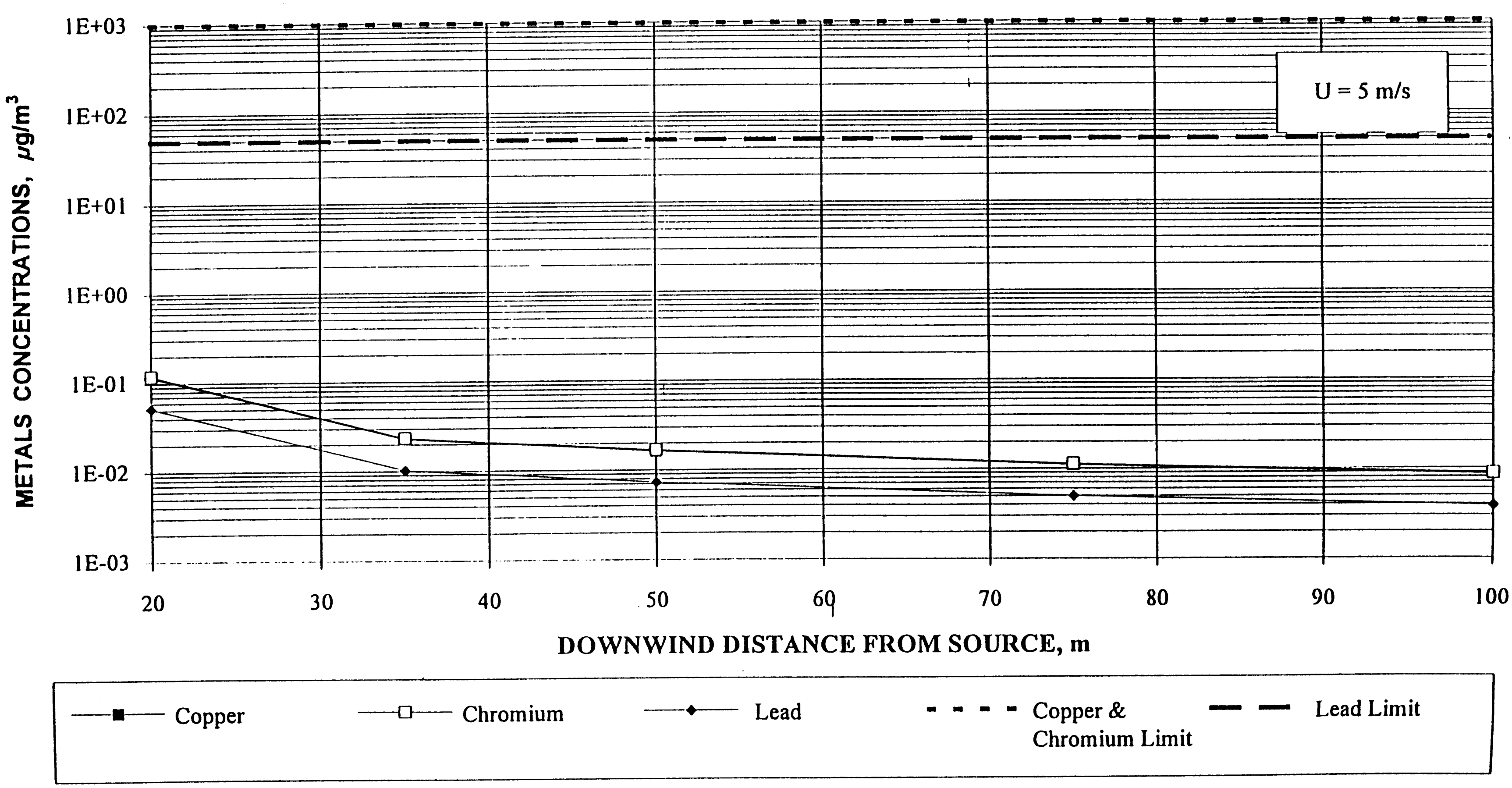



**Figure 6-4. Metals Concentrations ($\mu g/m^3$) Assuming a Uniform Velocity of 5 m/s.**

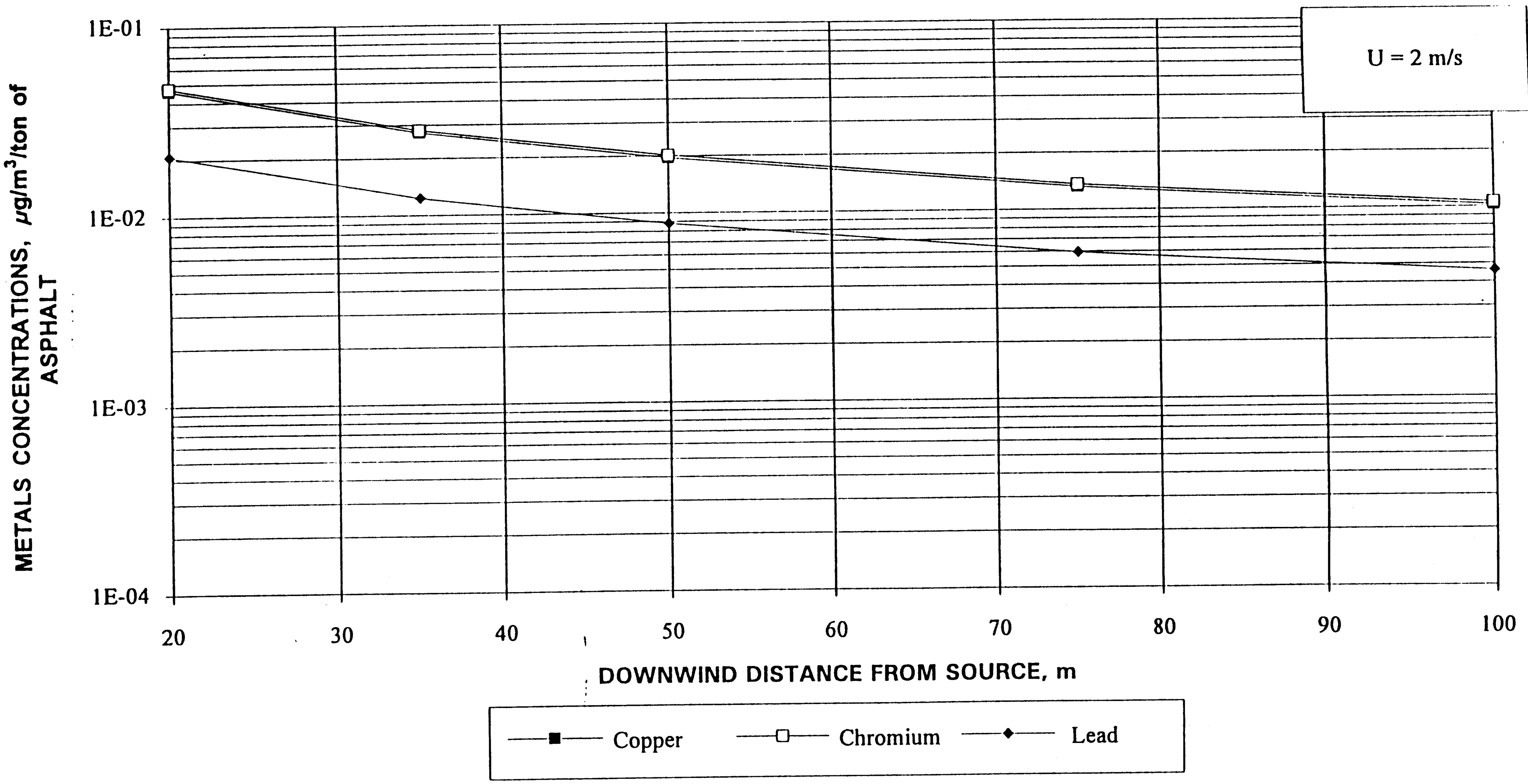



Figure 6-5. Normalized Curves of Metals Concentrations ($\mu g/m^3$) per Ton of Ground Asphalt Assuming a Uniform Velocity of 2 m/s.

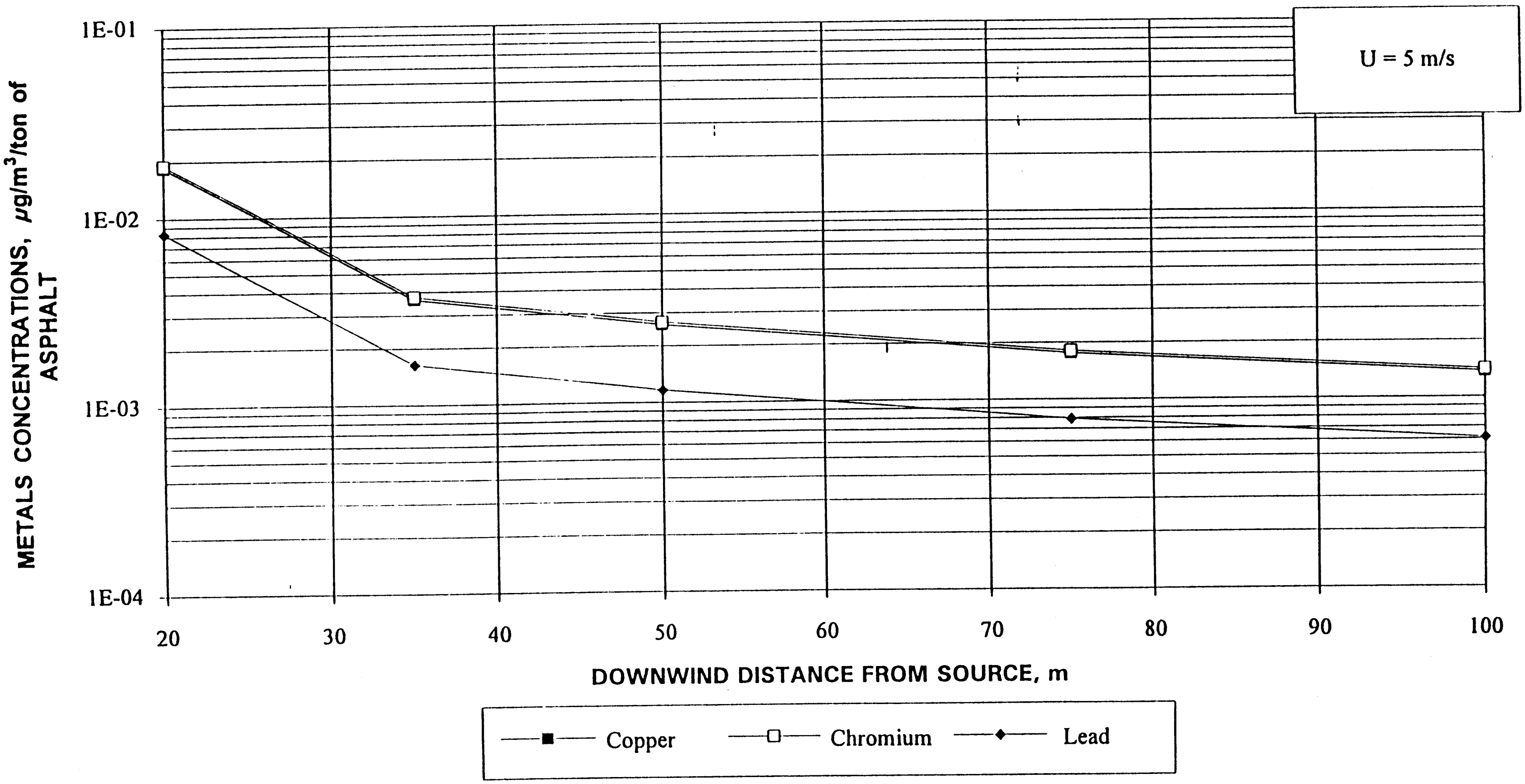



**Figure 6-6. Normalized Curves of Metals Concentrations ($\mu g/m^3$) per Ton of Ground Asphalt Assuming a Uniform Velocity of 5 m/s.**

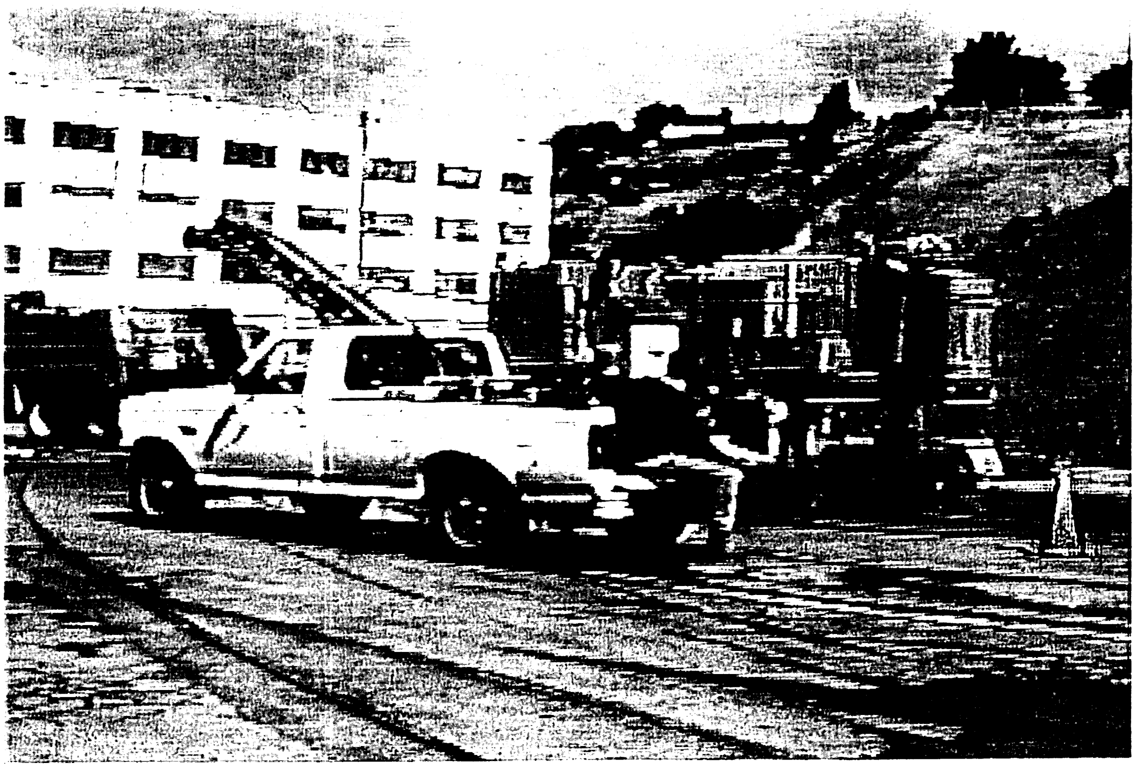


**Photo 6-3. Monitoring operations during the roadgrinding test at Hunters Point Annex.**

## 6.5 Analysis of Excess Asphalt Piles From the Pilot-Scale Test

Approximately 12 tons of excess asphaltic concrete was generated during the demonstration for the asphalt containing untreated sandblasting grit and approximately 10 tons was produced during the demonstration run for the treated sandblasting grit. Because the excess asphaltic concrete was suspected to contain low levels of sandblasting grit, it was stockpiled at a remote location on the Reed and Graham yard and chemically analyzed for total WET-soluble Cu and Pb content. The results (Table 6-17) show low levels of metals, well below the TTLC and STLC thresholds.

Based on the chemical analyses, Bob McCormack of California EPA DTSC approved the transfer of the excess asphaltic concrete into the general scrap asphalt pile at Reed and Graham on March 17, 1992. The scrap asphalt was eventually ground and recycled back into fresh asphalt as coarse aggregate.

**Table 6-17. Metal Analysis of the Excess Asphaltic Concrete Piles**

| | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| **Sample** | **Cu** | **Pb** | **Cu** | **Pb** |
| Excess asphalt with untreated grit | 110 | 20 | 1.8 | <0.05 |
| Excess asphalt with sulfide-treated grit | 76 | 9.8 | 0.42 | 0.07 |

# 7.0 FULL-SCALE MIXING AND PLACEMENT OF ASPHALTIC CONCRETE

This section describes the process activities, test methods, and results, of the full-scale field demonstration of recycling spent sandblasting grit into asphaltic concrete. Preparation of the spent sandblasting grit was performed at HPA in June 1994. Use of the grit in paving operations occurred between June 1994 and October 1995.

## 7.1 Identification of a Plant for Full-Scale Field Demonstration

A commercial hot-mix asphalt paving contractor was needed to participate in the full-scale field demonstration. The first criteria for the paving contractor were a willingness and an ability to efficiently and responsibly handle most or all of the 4,000 $yd^3$ of spent sandblasting grit at HPA at a reasonable cost per ton. It was also desirable to minimize the transportation distance from HPA to the paving facility.

More than 40 candidate contractors were identified by review of business directories for the area around HPA. The candidates were contacted by phone to determine their interest in and ability to participate in the field demonstration. The 27 companies actually contacted but not chosen are listed in Appendix J. The contractor review process led to selection of the Orland Asphalt plant of Jaxon Enterprises, Inc. The Navy, Battelle, and Jaxon Enterprises completed an extensive program of regulatory interaction to obtain the permits required for the full-scale field demonstration. Regulatory compliance activities are described in Section 3.0.

The first step in preparing for the field demonstration was to develop and test a formulation for asphaltic concrete containing spent grit with the materials and processes used at Orland Asphalt. Orland Asphalt, in conjunction with Caltrans, prepared asphalt core samples containing HPA sandblasting grit. Two cores each were prepared containing 5% untreated grit and 5% sulfide-treated grit, and one core was prepared containing no grit to serve as a control. The cores were analyzed for total and WET-soluble Pb and Cu content by two different California-certified analytical laboratories, and the results, similar to those described in Tables 6-9 through 6-12, show compliance with Cal EPA recycling criteria.

## 7.2 Full-Scale Grit Handling, Screening, and Transport

Spent sandblasting grit was screened at HPA in preparation for transfer to Orland Asphalt. The screening operation was conducted from June 1, 1994 to June 14, 1994. Grit was collected by a vacuum truck (see Photo 2-3) from eight small piles (see Table 2-1) for processing along with grit from the untreated and sulfide-treated piles. The conveyors, screen, and air monitors were set up near the larger grit piles, as shown in the general arrangement plan view (Figure 7-1). Grit was removed from a pile with a front-end loader and dropped through a grizzly to remove oversize debris prior to loading on a conveyor (see Photo 7-1). The conveyor lifted the grit and discharged to the top of a screen. Oversize material rolled off the top of the screen while acceptable grit fell through to be collected by the second conveyor (see Photo 7-2). The screen was selected to pass material with a particle size under ½-inch. The second conveyor was periodically pivoted around the screen to distribute the screened grit. The configuration of the screening apparatus is shown in Figure 7-2.

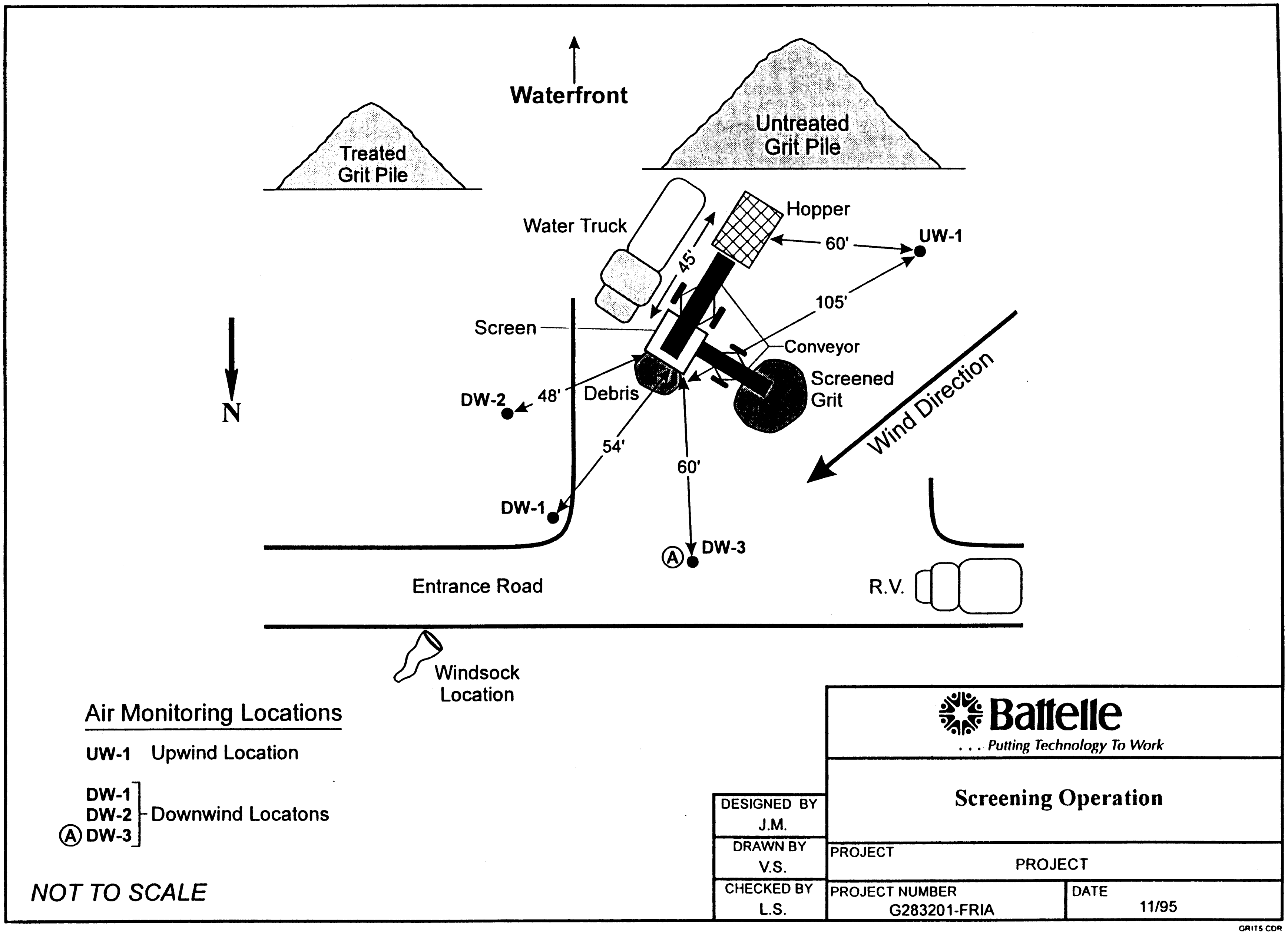



Figure 7-1. General Arrangement Plan View of the Sandblasting Grit Screening and Air Monitoring Equipment

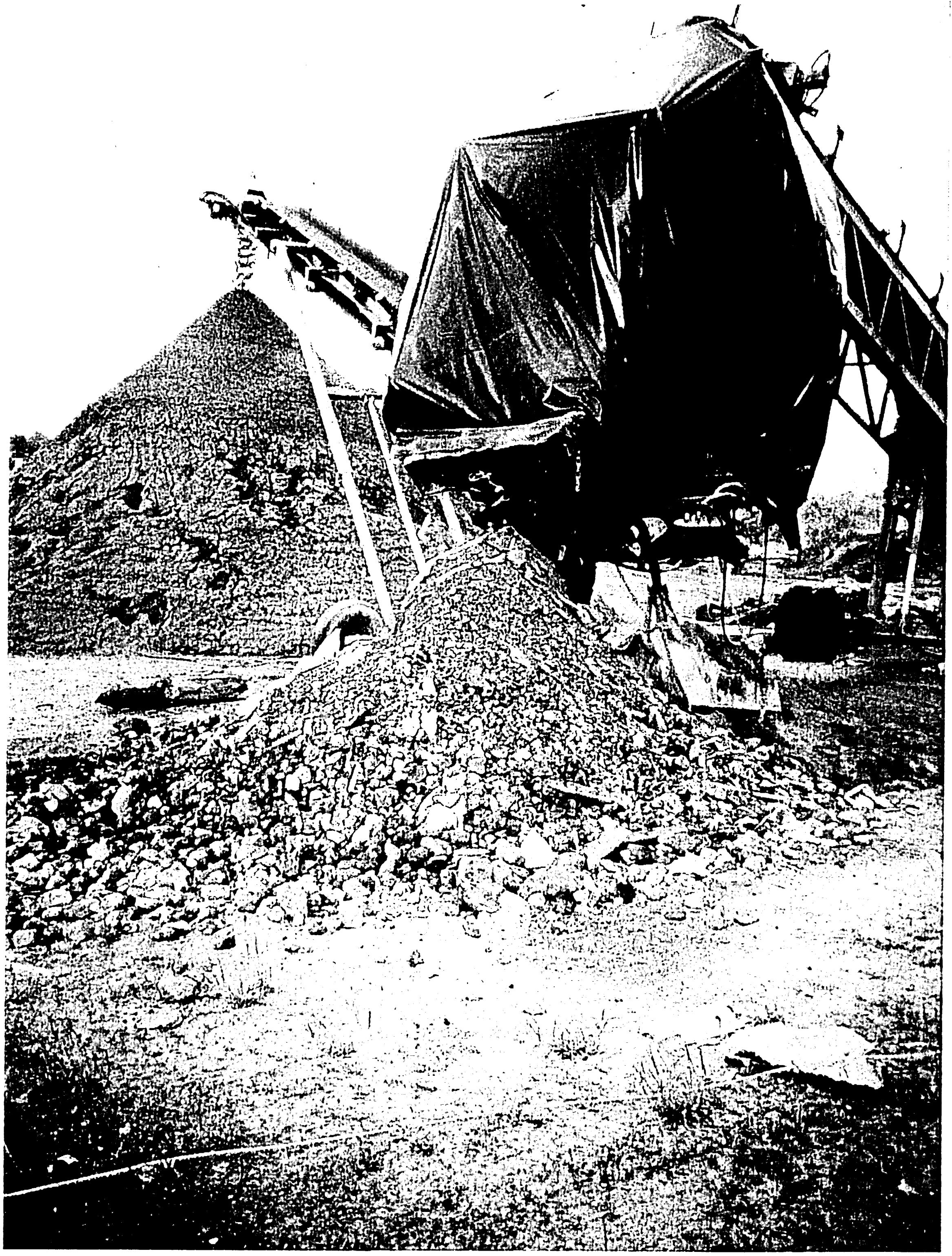


**Photo 7-1. Debris pile left over from screening operations (debris in foreground and screened grit in background).**

**Photo 7-2. Screened grit emerging from the screening process.**

Screening removed oversized clumps of spent grit as well as wood, cloth, and metal debris. The oversize material rejected by the screen was crushed using a sheep's foot roller to break up clumps and rescreened. The oversize material pile was crushed and rescreened several times to minimize the quantity of rejected oversize material. The resulting piles were then covered by tarps to minimize dust emissions (Photo 7-3).

Moving, screening, and crushing could produce fugitive dust. Water spray (Photo 7-4) was provided to minimize dust production, but monitoring was required to ensure that the preventative measures were sufficient (Photo 7-5). Miniature real-time aerosol monitor (MINIRAM) airborne particulate sample collectors were placed at one upwind and three downwind locations. In addition to the particulate samples, hand-held field screening instruments were used to periodically monitor for contaminants near the surface of grit areas recently exposed by the excavation. Periodic field surveys were performed for gross beta/gamma radioactivity, sulfide vapors, and volatile organic compounds (VOCs) (Photo 7-6).

In accordance with conditional use Permit #93-10 Item 28, issued by the Glenn County Planning Committee, spent sandblasting grit was not shipped into Glenn County until assurances by Caltrans or other public agencies were secured allowing use of the material in paving. The sandblasting grit was transported from HPA to Orland Asphalt in covered trucks. Each truck carried about 24.5 tons of grit. Photos 7-7 and 7-8 show the truck loading operations. The truck drivers were provided a documentation package describing the chemical composition of the grit, directions to Orland Asphalt, and a list of agencies to contact in case of an accident (Photo 7-9). An example transportation plan is shown in Appendix K.

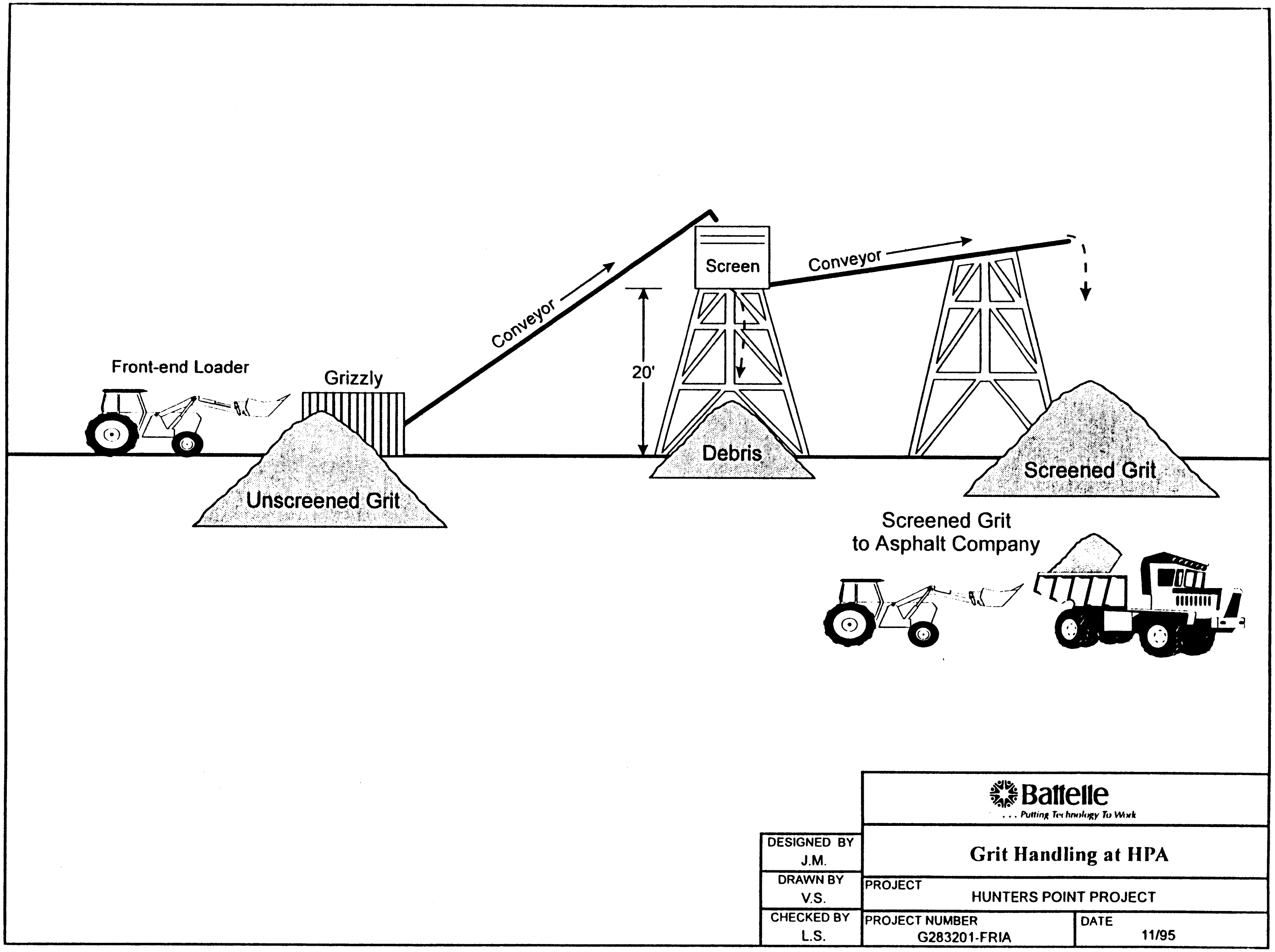



**Figure 7-2. Layout of Sandblasting Grit Handling and Screening Equipment**

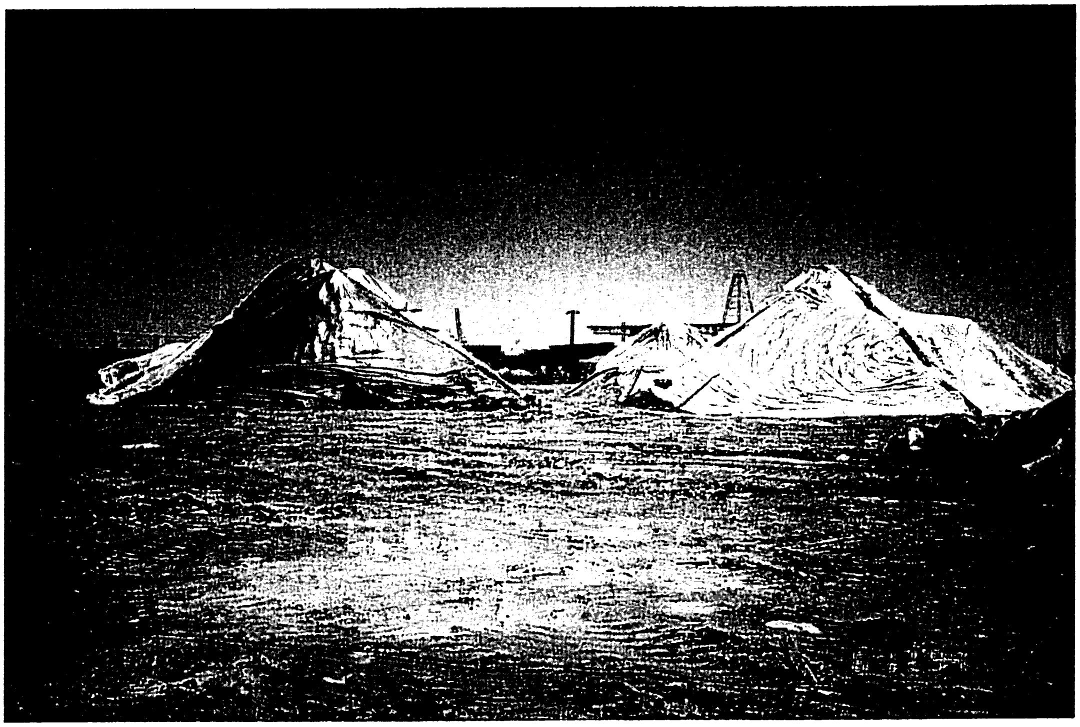


**Photo 7-3. Covered grit piles awaiting transport to the asphalt hot plant.**

**Photo 7-4. Wetting the grit during screening operations to reduce dust emissions.**

**Photo 7-5. Checking air monitors during screening.**

The total amount of grit recycled in the full-scale field demonstration was 4,665 tons, as determined by the weights of the trucks. The storage area at the Orland Asphalt plant could accommodate at most 2,000 tons. Therefore, transportation occurred in three campaigns. The first campaign proceeded during the screening operations (June 4, 1994 to June 6, 1994) and invovled moving 1,971 tons of grit. The second hauling operation, which occurred between October 26, 1994 and October 28, 1994, resulted in moving 1,121 tons of grit. The last haul occurred between July 21, 1995 and July 23, 1995, and resulted in moving 1,573 tons of grit.

## 7.3 Debris Disposal

As described in Section 2.3.3, several grab samples of wood, cloth, and metal debris were collected from the untreated grit pile. Some samples exceeded California or RCRA hazardous waste criteria. Based on these results, all oversize material was disposed of as hazardous waste to a Class I facility. A total of about 293 $yd^3$ of debris was shipped in 13 batches ranging from 20 $yd^3$ to 25 $yd^3$, each for a cost of $55,425. (The conversion factor for debris volume to debris is about 1 $yd^3$ = 0.771 ton.) Debris disposal was provided by Chemical Waste Management of Kettleman Hills, California (Photo 7-10). An example waste profile for the debris is included in Appendix L.

Once the screened grit had been hauled away and the debris removed from the area, the area where the original grit pile had been was cleaned up and graded. Photos 7-11 through 7-14 offer a panoramic view of the cleaned-up site at HPA.

**Photo 7-6. Surveying the screened grit for radioactive materials.**

**Photo 7-7. Trucks waiting to pick up screened grit.**

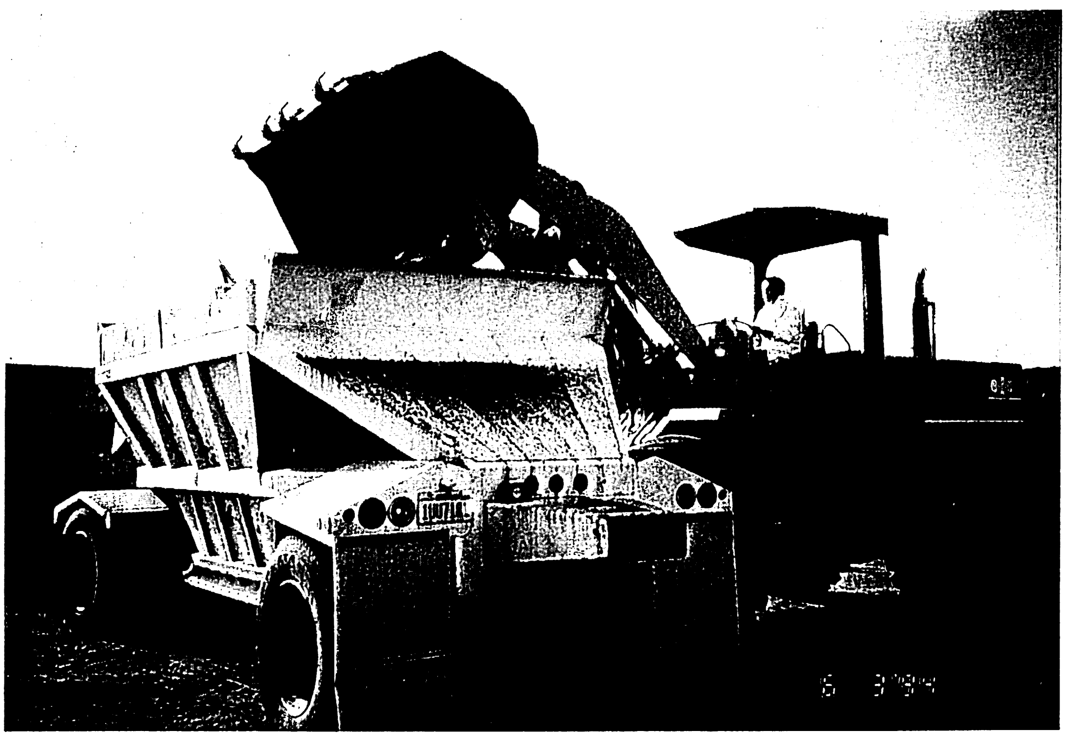


**Photo 7-8. Loading the screened grit prior to transport to Orland Asphalt.**


**Photo 7-9. Truck drivers receiving instructions and information packets.**

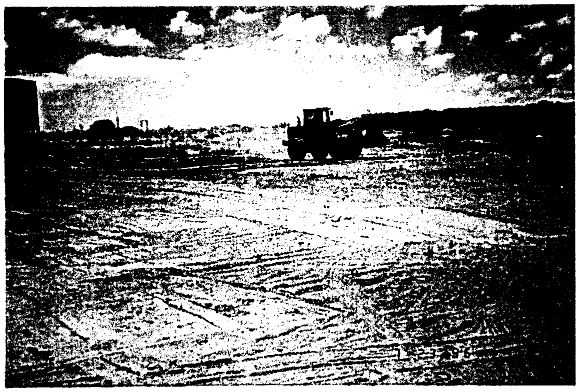

**Photo 7-10. Debris and waste piles being loaded into rolloff bins for disposal at a hazardous waste landfill.**

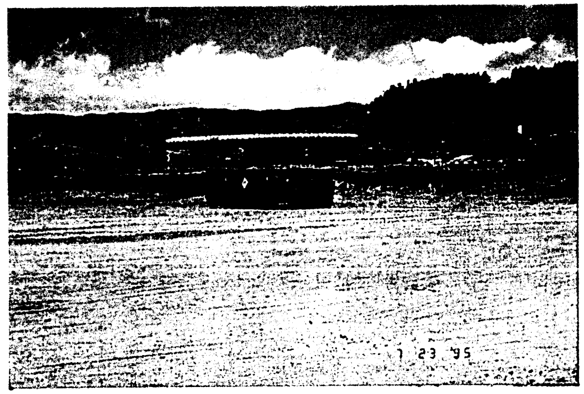
### 7.4 Full-Scale Hot-Mix Asphalt Preparation

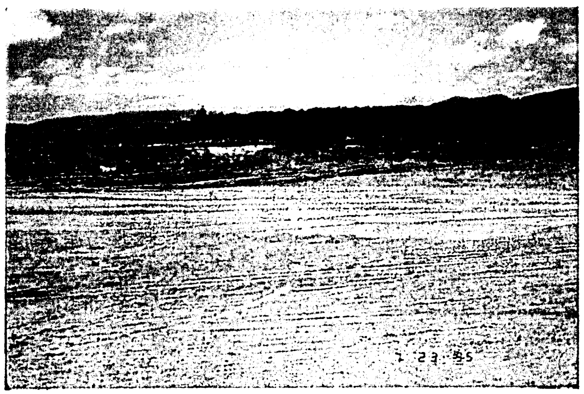
Asphaltic concrete or asphalt is a mixture of viscous bitumen and a size-graded mineral aggregate. Asphalt is used in a paving applications ranging from paving or resurfacing highways to covering parking lots and playgrounds. Hot-mix asphalt is a mixture of liquid asphalt and graded aggregate used as a paving material for roadways and parking lots. It is spread and compacted in layers over a prepared base while still hot.

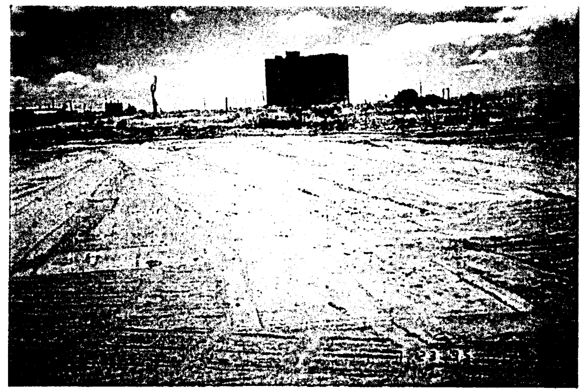
Asphalt mix plants (see Figure 7-3) are usually permanent plants, because asphalt plants normally serve a great many ongoing small, new surfacing, and resurfacing projects in a geographic area. The usual functions of a hot-mix asphalt mix plant are:

- storage of liquid bitumen and aggregates
- aggregate handling
- heating and drying of aggregates
- aggregate grading and mixing
- batching and mixing of aggregate and bitumen
- discharge of hot, prepared asphalt paving material.







**Photos 7-11 through 7-14. The site of the original grit pile was cleaned and graded following removal of the screened grit pile and debris materials.**

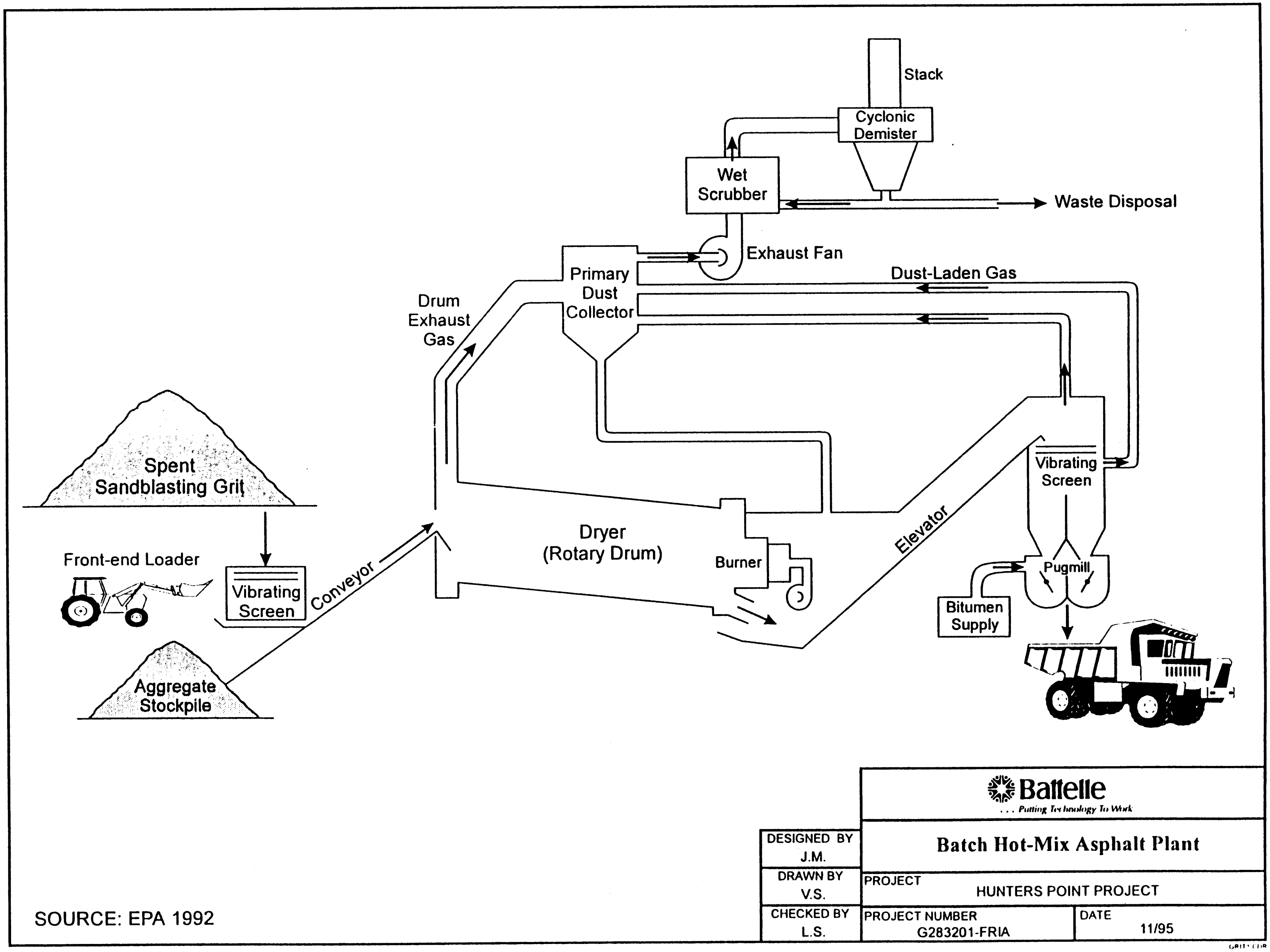



**Figure 7-3. Process Schematic for a Hot-Mix Asphalt Plant.**

The typical steps in hot-mix asphalt production can be described as follows:

1. Sand and two or three sizes of coarser aggregate are kept in stockpile. Hot liquid bitumen is stored in a tank which is equipped with a heater to keep the bitumen fluid.

2. Aggregates are loader-fed into low-profile, cold feed bins. The gates of these bins are cracked to meter out the aggregates in rough proportion to their final batched weight. A conveyor located under these bins feeds the aggregate to another conveyor, which feeds into the dryer.

3. The dryer is a rotating drum with fins that toss the aggregate as hot air moves through the dryer counter current to the aggregate flow. (Aggregate must be completely dry to adhere well to bitumen.)

4. Dried aggregate is fed into vibrating screens in the gradation unit, which divides it into specified separations.

5. Each separation flows into its own bin, from which it flows in weighed batches to the pugmill where it is mixed with a weighed amount of fluid asphalt.

For use at Orland Asphalt, spent grit was stored in an area constructed to prevent seepage and runoff. The sandblasting grit storage area was an 80-foot by 80-foot asphaltic concrete pad with an impervious liner installed in the asphalt to prevent seepage of any substances (Photos 7-15 through 7-17).

The grit storage pad was located approximately 30 feet from the designated feeder to facilitate the most efficient, least hazardous travel pattern for the loader. Travel from pad to pile will be approximately 85 feet in reverse and 65 feet forward to the feed bin (Photo 7-18).

To minimize the possibility of mixing spent grit with clean aggregate, a storage bin was dedicated for use of temporary storage of sandblasting grit only. A loader was dedicated for transport of the sandblasting grit only during jobs using the sandblasting grit. The pile was covered when not in use. The cover was partially rolled back on the downwind side to allow wetting, if needed, to control dust generation during movement of the spent sandblasting grit.

The recyclable sandblasting grit was incorporated into asphalt as a normal component of the mixture. The sandblasting grit was targeted to be 5% of the total asphalt mixture.

A 25-ton feed hopper equipped with a variable-speed control for proper percentage blend was designated for use with the sandblasting grit. The grit hopper fed onto an existing collecting conveyor along with the Stony Creek rock and sand. The grit, rock, and sand were proportioned as a job mix required. As discussed in Section 8.0, during brief periods the grit component may have reached as high as 10% of the total mix due to the precision limitations of the aggregate feed-proportioning equipment.

The hot-mix asphalt material was discharged directly into a truck or — if no truck was ready — into an insulated surge bin where the required mix temperature could be maintained up to 24 hours. In colder weather or for longer hauls, the trucks would be insulated with insulation bats

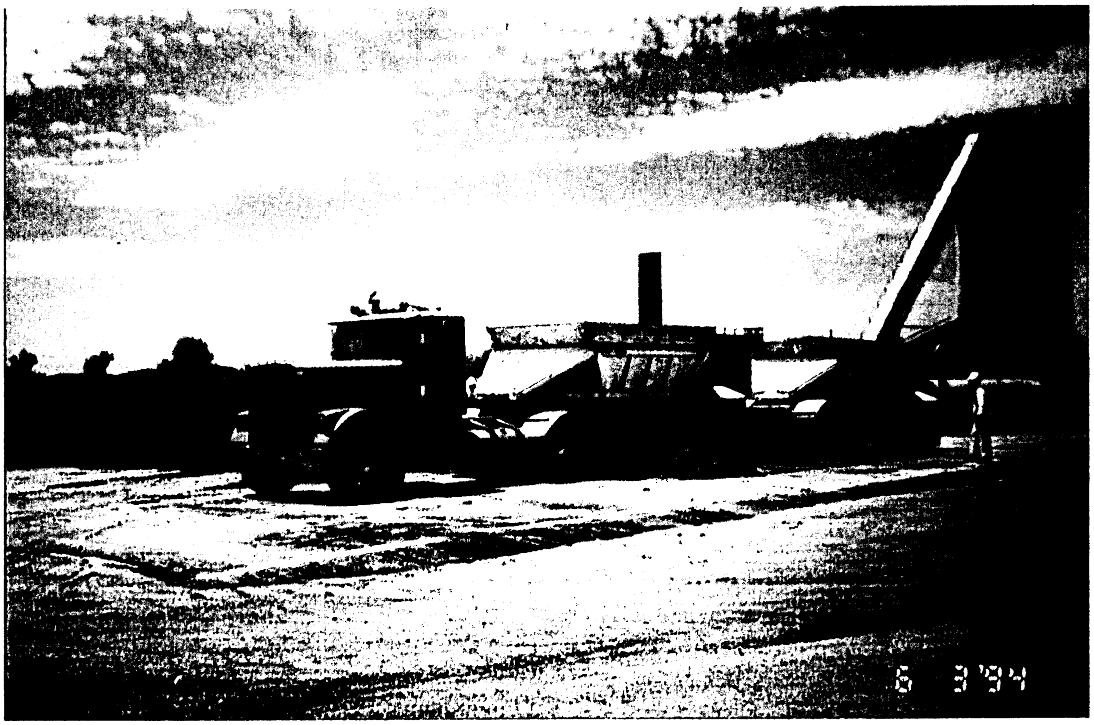


Photo 7-15. Unloading screened grit onto the lined storage pad at Orland Asphalt.

Photo 7-16. The screened grit was covered by a tarp after being loaded onto the pad.

**Photo 7-17. Storage of the sandblast grit at Orland Asphalt when not in use.**

along the sides, and a trap over the top. The asphalt mix must be hot enough to be plastic when it is placed (see Photos 7-19 and 7-20).

A "baghouse" is usually connected to the dryer to take off the excess dust and shake it down to the bottom where it can be collected and disposed of.

### 7.5 Full-Scale Asphalt Placement

Asphalt is considered to be a "flexible" pavement requiring a firm base, so asphalt pavements are always laid on a subbase or old pavement. Subbase materials may be bank-run (unprocessed) sand and gravels, crushed rock such as limestone, or recycled portland cement or asphaltic concrete. All bases must be compacted to meet specifications prior to placement of the asphalt. Before placing asphalt, the subbase may be sprayed with hot liquid asphalt to provide a "tack coat" which helps bind the subbase to the asphalt mix.

Asphalt is placed with a simple paving train consisting of an asphalt paver and one or two vibratory, smooth-wheel compactors. Trucks back up to the hopper in front of the paver to load asphalt into it. The hopper is raised to feed asphalt through opened gates and under an auger which spreads the mix uniformly across the area to be paved. Behind the auger is an adjustable screen which sets the thickness of the loose lift. Two or more lifts of asphalt will be required for new pavement.

Photo 7-18. This feed hopper was located close to the lined storage pad to minimize spillage.

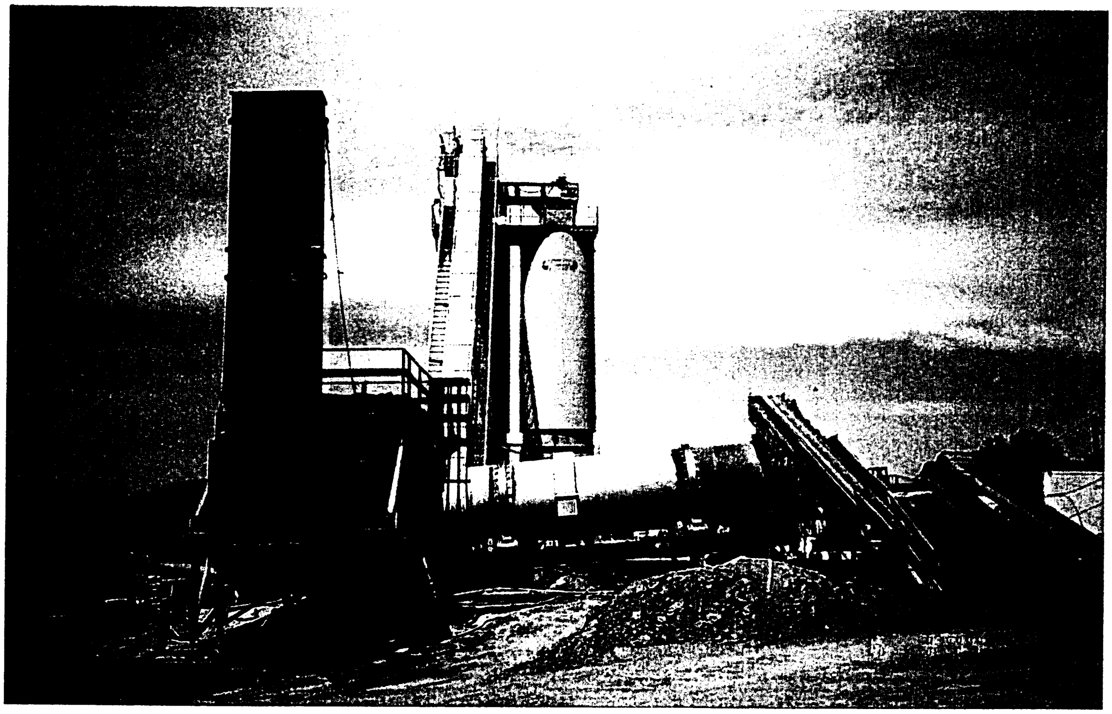


**Photo 7-19. The hot asphalt plant at Orland Asphalt.**

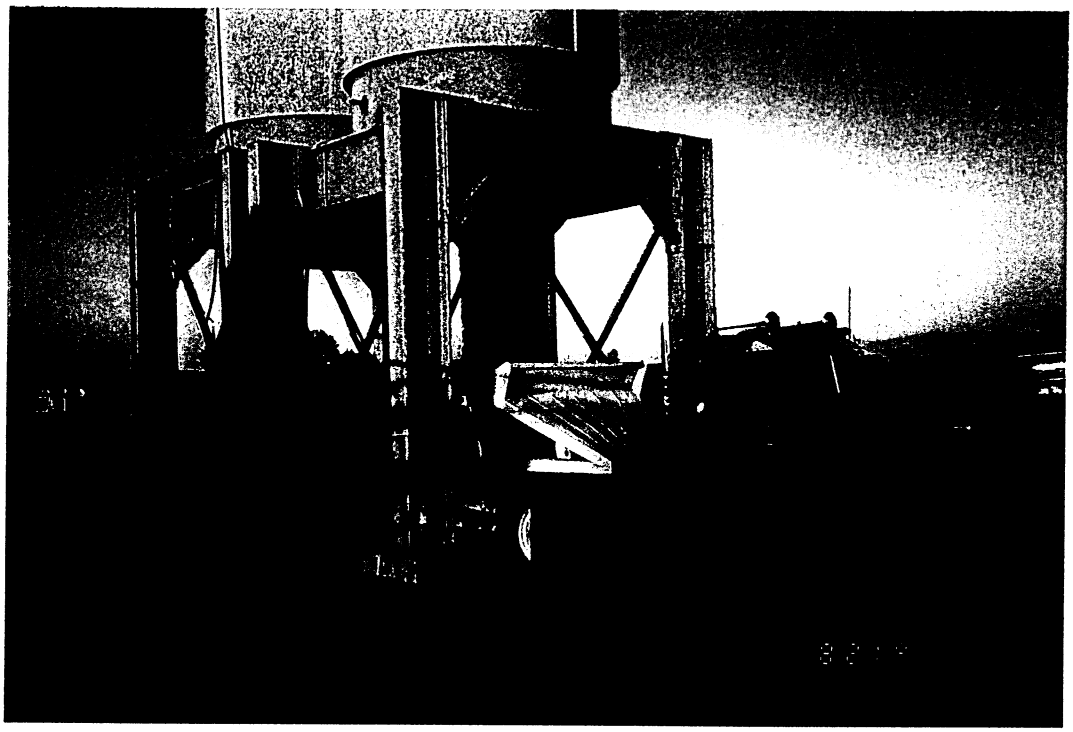


**Photo 7-20. Production of grit-containing asphalt.**

The loose asphalt lift is compacted immediately after it is placed using vibratory, smooth-wheeled rollers equipped with a small water tank from which water sluices constantly over the roller drum. If the roller wheels are dry, the asphalt sticks, causing the roller to pick up globs of fresh paving material. The resulting lumpy roller loses the ability to achieve a smooth surface.

## 7.6 Decontamination of the Asphalt Plant

After all of the spent sandblasting grit was used for making asphalt, the asphalt plant was decontaminated to manage unrecyclable material and to clean equipment that had contacted spent grit. All of the decontamination wastes were managed by disposal as California hazardous wastes using a container provided by Chemical Waste Management, Inc. Unrecyclable material, such as the plastic sheeting used to cover the pile, was placed into the hazardous waste container for disposal. All areas and equipment items that contacted spent sandblasting grit were inspected and cleaned to remove any small accumulations of spent grit. The surfaces were then decontaminated by hand wiping with wet towels. The areas cleaned included the pad that was used as the temporary staging area for spent girt; the loaders used to handle the grit; and the storage silo, dryer, and conveyers used to process the grit. Cleaning wastes were placed into the hazardous waste container for disposal.

# 8.0 TEST RESULTS FROM THE FULL-SCALE FIELD DEMONSTRATION

This section discusses the results of (1) the air monitoring activities that were conducted during the full-scale demonstration (June 1994) and (2) the chemical and physical testing conducted on grit-containing asphalt prepared at the Orland Asphalt plant (July 1994 to September 1995).

## 8.1 Air Monitoring Results During Full-Scale Asphalt Production

The spent sandblasting grit is a coarse-grained sand and does not contain large quantities of fine and easily dispersed material. The primary source of airborne fugitive dust emissions was the operation of heavy equipment. This factor was easily overcome by the occasional addition of water to the work area using a water truck.

Although the dust was suppressed with little effort, an air monitoring program designed to provide adequate measurements of dust releases was implemented. This monitoring program confirmed that the method of suppressing the airborne dust emissions was sufficient.

Particle dust monitors (MINIRAMs) were used at various locations (see Figure 7-1). The MINIRAM enabled continuous work-shift monitoring with full data storage capacity. The MINIRAM is a battery-operated instrument with programmable alarm levels.

The use of three MINIRAM units was proposed, but upon observation of the wind direction and accessibility for MINIRAM placement, it was decided to add a fourth unit.

The MINIRAM units were placed as follows:

- One at a convenient upwind location for establishing threshold levels.
- Three at convenient downwind locations, all of which were placed within relatively close range of the work area.

The upwind and downwind locations were determined by the monitoring technician based on the wind direction as measured by a wind sock and any other varying weather conditions during the work shift. The weather conditions at no point during the monitoring caused methods or instruments to be changed or relocated. The technician did a real-time visual check of each instrument when conditions appeared to get dusty.

The action level for the operation was 5 $mg/m^3$. At this point the alarm level indicator set for 5 $mg/m^3$ would be tripped. The technician would evaluate the situation for possibilities of change to enhance the dust control, while recording the changes as well as the instruments reading. During the operations, the readings at no time exceeded the limits set. The results are shown in Table 8-1.

Table 8-1. Daily MINIRAM Readings

| Date | MINIRAM Location | 10-sec Interval Daily Average[a] ($mg/m^3$) |
|---|---|---|
| 06/01/94 | Upwind-1 | 0.08 |
| 06/02/94 | Upwind-1 | 0.0 |
| 06/03/94 | Upwind-1 | 0.0 |
| 06/01/94 | Downwind-1 | 0.0 |
| 06/02/94 | Downwind-1 | 0.0 |
| 06/03/94 | Downwind-1 | 0.03 |
| 06/01/94 | Downwind-2 | 0.0 |
| 06/02/94 | Downwind-2 | 0.2 |
| 06/03/94 | Downwind-2 | 0.0 |
| 06/01/94 | Downwind-3 | 0.0 |
| 06/02/94 | Downwind-3 | 0.46 |
| 06/03/94 | Downwind-3 | 0.46 |

(a) Each reading is the daily average of the every 10-second reading that each instrument read that day.

## 8.2 Results of Testing Asphaltic Concrete Prepared During Full-Scale Asphalt Production

The results of the total and WET-soluble Cu and Pb analyses on 14 grit-containing asphalt samples produced for Caltrans paving projects from July 1994 to September 1995 are shown in Table 8-2. One sample was collected for approximately every 350 tons of grit recycled.

For Cu, the WET-leachable Cu concentration averaged 0.34 mg/L and the total Cu concentration averaged 36.7 mg/kg. Several spikes in the WET Cu concentration were observed, particularly in samples 4 and 6. However, based on the higher than average total Cu and Pb concentrations in these samples, it is clear that these particular batches of asphalt contained more than 5% grit. A comparison of the total Cu and Pb data for these two samples with the other samples suggests a 10% or higher grit concentration.

Compliance with the Caltrans recycling criteria in Appendix C is tested below using the dilution calculation approach developed in Tables 6-9 through 6-12.

**Table 8-2. Chemical Data for Cu and Pb from the Full-Scale Recycling Field Demonstration (7/94–9/95)**

| Sample | Date Sampled | Total Cu (mg/kg) | WET Cu (mg/L) | Total Pb (mg/kg) | WET Pb (mg/L) |
|---|---|---|---|---|---|
| Control (no grit) | 5/94 | | <0.2 | | < 0.07 |
| #1 | 7/26/94 | 72 | 1.1 | 7.8 | 0.10 |
| #2 | 8/16/94 | 47 | 0.92 | 9.2 | 0.08 |
| #3 | 9/18/94 | 52 | 0.98 | <5.0 | 0.07 |
| #4 | 10/3/94 | 100[a] | 3.2 | 31 | 0.17 |
| #5 | 10/6/94 | 15 | 0.1 | <2.5 | 0.031 |
| #6 | 10/10/94 | 110[a] | 2.1 | 19 | 0.26 |
| #7 | 10/17/94 | 82 | 0.85 | 11 | 0.12 |
| #8 | 6/28/95 | 30 | <0.1 | 6.2 | <0.5 |
| #9 | 7/5/95 | 18 | <0.1 | 3.6 | <0.5 |
| #10 | 7/12/95 | 17 | <0.1 | 3.4 | <0.5 |
| #11 | 7/25/95 | 24 | <0.1 | 5.7 | <0.5 |
| #12 | 9/6/95 | 22 | 0.38 | 6.0 | <0.5 |
| #13 | 9/18/95 | 23 | 0.35 | 7.4 | <0.5 |
| #14 | 9/29/95 | 30 | 0.65 | 5.2 | <0.5 |
| Mean[b] | | 36.7 | 0.34 | 6.27 | 0.16 |
| 95% Upper Confidence Limit[b] | | 46.9 | 1.08 | 8.79 | 0.20 |

(a) Result indicates recycled grit concentration is higher than 5% target.
(b) Calculated using a log-normal distribution.

For the average WET Cu concentration of 0.34 mg/L:

$$\begin{array}{ll} & 0.34 \text{ mg/L} \\ \underline{-0.10} & \text{(50\% of} <0.2 \text{ mg/L Cu in control)} \\ & 0.24 \text{ mg/L} \\ \underline{\times \;\; 20} & \text{(assuming a 5\% grit content in the asphalt)} \\ & 4.8 \text{ mg/L} \end{array}$$

This volume of 4.8 mg/L average WET Cu content of the grit-containing asphalt (after correcting for background Cu and dilution) is more than five times lower than the STLC for Cu (25 mg/L — see Table 2-3).

Using the 95% upper confidence limit for Cu (1.08 mg/L, which is strongly influenced by the two outlier values of 3.2 and 1.1 mg/L):

$$\begin{array}{ll} & 1.08 \text{ mg/L} \\ - & \underline{0.10} \\ & 0.98 \\ \times & \underline{20} \text{ (assuming a 5\% grit content in the asphalt)} \\ & 19.6 \text{ mg/L vs. STLC for Cu of 25 mg/L} \end{array}$$

Therefore, using the 95% upper confidence limit of the WET Cu data from the asphalt-containing grit, corrected for background and dilution and including two outliers where the total grit concentrations clearly excceded 5%, the WET Cu concentrations are in compliance with the Cal EPA recycling criteria.

For Pb, the same result is obtained, except that the asphalt matrix immobilizes Pb more effectively than Cu, and the dilution-corrected WET Pb concentrations are even farther below the STLC for Pb of 5 mg/L.

Using the 95% upper confidence interval for WET Pb (0.20 mg/L):

$$\begin{array}{ll} & 0.20 \text{ mg/L} \\ - & \underline{0.07} \\ & 0.13 \text{ mg/L} \\ \times & \underline{20} \text{ (assuming a 5\% grit concentration)} \\ & 2.6 \text{ mg/L vs. the STLC for Pb of 5.0 mg/L} \end{array}$$

Therefore, the analytical data show that Cal EPA metals leachability criteria for recycling are met for Cu and Pb at the 95% upper confidence limit in both cases.

The physical characteristics data in Tables 8-3 and 8-4 also show that the grit-containing asphalt from full-scale production meets or exceeds the Cal EPA recycling criteria relating to the production of a high-quality product. Of 13 samples tested, only one had a Hveem stabilimeter value significantly below 35 (Sample 4 — see Table 8-4). This sample also pumped oil upon compaction, indicating an excess of bitumen for this particular batch. Lower than standard Hveem stabilimeter values are not unusual in freshly laid asphalt, and do not necessarily indicate an inferior product. Some of the oil tends to volatilize over time and the associated stabilimeter values increase as a result (e.g., see Table 6-13 on data from long-term test strips).

Table 8-3. Grading Analysis Results for Asphalt Samples for Full-Scale Recycling Field Demonstration (Percent Passing)

| Sample | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10[a] | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | 7/26/94 | 8/16/94 | 9/18/94 | 10/3/94 | 10/6/94 | 10/10/94 | 10/17/94 | 6/28/95 | 7/5/95 | 7/12/95 | 7/25/95 | 9/6/95 | 9/18/95 | 9/29/95 |
| Sieve Size | | | | | | | | | | | | | | |
| 1″ | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | | 100 | 100 | 100 | 100 |
| ¾″ | 100 | 100 | 100 | 100 | 98 | 100 | 100 | 100 | 100 | | 100 | 100 | 98 | 96 |
| ½″ | 100 | 100 | 100 | 89 | 94 | 95 | 92 | 88 | 88 | | 88 | 93 | 88 | 75 |
| ⅜″ | 94 | 93 | 91 | 77 | 83 | 81 | 77 | 77 | 74 | | 76 | 78 | 77 | 67 |
| ¼″ | 68 | 69 | 68 | 57 | 67 | 57 | 59 | 59 | 59 | | 59 | 59 | 58 | 53 |
| #8 (2.38 mm) | 49 | 50 | 48 | 38 | 49 | 38 | 42 | 45 | 45 | | 44 | 45 | 42 | 40 |
| #16 (1.19 mm) | 35 | 35 | 32 | 25 | 31 | 26 | 27 | 31 | 31 | | 30 | 30 | 29 | 27 |
| #30 (0.59 mm) | 24 | 24 | 21 | 17 | 20 | 18 | 18 | 21 | 20 | | 20 | 19 | 19 | 18 |
| #50 (0.30 mm) | 15 | 14 | 12 | 11 | 12 | 12 | 12 | 11 | 11 | | 11 | 11 | 11 | 10 |
| #100 (0.149 mm) | 9 | 8 | 6 | 7 | 8 | 8 | 8 | 7 | 7 | | 7 | 7 | 6 | 6 |
| #200 (0.074 mm) | 7 | 6 | 4 | 5 | 6 | 6 | 6 | 5 | 5 | | 5 | 4 | 5 | 4 |

(a) Not analyzed.

## Table 8-4. Physical Analysis Results for Asphalt Samples for Full-Scale Recycling Demonstration

| Sample | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10[a] | 11 | 12 | 13 | 14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date Sampled | 7/26/94 | 8/16/94 | 9/18/94 | 10/3/94 | 10/6/94 | 10/10/94 | 10/17/94 | 6/28/95 | 7/5/95 | 7/12/95 | 7/25/95 | 9/6/95 | 9/18/95 | 9/29/95 | |
| Test Performed | | | | | | | | | | | | | | | Acceptance Criteria |
| Percent oil by weight of aggregate (%) | 5.5 | 5.7 | 4.5 | 5.5 | 5.5 | 5.7 | 5.9 | 5.2 | 5.1 | | 5.0 | 5.3 | 5.2 | 4.9 | |
| Percent oil by weight of mix (%) | 5.2 | 5.4 | 4.3 | 5.2 | 5.2 | 5.4 | 5.6 | 4.9 | 4.8 | | 4.8 | 5.1 | 5.0 | 4.7 | |
| Maximum theoretical unit weight (ASTM D-2041) (PCF) | 157.7 | 156.4 | 156.3 | 157.4 | 157.4 | 156.9 | 157.1 | 160.2 | 158.9 | | 158.1 | 158.8 | 157.9 | 157.9 | |
| Laboratory compacted unit weight (Cal 308) (PCF) | 151.5 | 152.4 | 149.5 | 153.2 | 152.4 | 153.5 | 154.4 | 151.2 | 151.5 | | 150.6 | 153.3 | 151.1 | 151.7 | |
| Percent voids (%) | 3.9 | 2.5 | 4.4 | 2.7 | 3.2 | 2.2 | 1.7 | 5.6 | 4.7 | | 4.7 | 3.5 | 4.3 | 3.9 | 4 (min) (-) 8 (max)[b] |
| Hveem stabilimeter value (Cal 366) | 40 | 35 | 40 | 27 | 47 | 36 | 32 | 42 | 35 | | 38 | 39 | 34 | 38 | 35 (min)[c] |
| Compacted appearance of Hveem specimens | stable | moderate flushing | moderate flushing | flushing pumping | slight flushing | flushing | flushing | stable | stable | | stable | very slight flushing | stable | stable | |
| Swell (CA 305) (in) | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.004 | 0.000 | 0.000 | 0.000 | | 0.000 | 0.002 | 0.000 | 0.000 | 0.030 in (max) |
| Cohesiometer (CA 306) | 397 | 333 | 357 | 240 | 499 | 325 | 265 | 508 | 359 | | 461 | 426 | 377 | 478 | 50 (min)[d] |

(a) Not analyzed.
(b) Asphalt Institute (1962) criteria; minimum value for HVEEM test, maximum value as listed for Marshall test. Note that there is no maximum % voids value for the HVEEM test in the Asphalt Institute (1962) criteria.
(c) Caltrans criteria for medium-traffic applications.
(d) Asphalt Institute (1962) criteria.
PCF = pounds per cubic foot.

# 9.0 SUMMARY AND CONCLUSIONS

The Navy generates spent sandblasting grit as a result of cleaning and maintaining ships. The spent grit can be managed as a waste, but disposal is both expensive and the lowest option in the waste management hierarchy (see Figure 9-1). The spent grit has desirable physical properties that may allow its reuse to decrease waste management costs and eliminate the environmental impact caused by spent grit disposal.

This project explored the option of reusing spent grit as the aggregate in asphaltic concrete. The program evolved from initial characterization of several accumulations of spent grit, through bench- and pilot-scale testing, and culminated in a full-scale field demonstration. The program determined that recycling spent sandblasting grit as asphalt aggregate can be an effective and relatively inexpensive option (compared to treatment and/or disposal), so long as there is a well thought-out plan for the recycling operation and the project is conducted in full compliance with relevant regulations, codes, and/or policies. The following is a brief discussion of advantages, disadvantages, and several cautions pertaining to recycling. A more extensive discussion is provided in Volume II of this final report.

## 9.1 Advantages

1. The cost of recycling spent sandblasting grit into asphaltic concrete is much lower than the cost of disposal.

2. The recycling and reuse option is higher in the hierarchy of hazardous waste management than disposal with or without treatment options (Figure 9-1). Furthermore, waste minimization credit may be given to the generator of the spent grit because the spent grit is not manifested as hazardous waste then it is transported to the asphalt plant for recycling.

3. The recycling option does not consume valuable landfill space, which can be reserved for more toxic or dangerous wastes. Most spent grit contains relatively low metal concentrations and poses negligible risk.

## 9.2 Disadvantages

1. If the spent grit is hazardous, the material needs to be handled as a hazardous material (although not as a hazardous waste) and must comply with cognizant transportation, storage, handling, and reporting regulations. Also, regulatory requirements must be satisfied or a permit or variance may be required.

2. Different types of spent grit have varying particle sizes and differing capacities to adhere to bitumen used in asphalt. Therefore, bench-scale or laboratory testing and analyses are required to design the optimal mix of ingredients to give a stable product.

3. Constituents that may be present in grit can interfere with the production of high-quality asphalt. High organic content (such as from paint chips and other organic coatings) is

**First Choice (Pollution Prevention):**
**Reduce/Eliminate Waste Production at the Source**

- Design Long-Lived, Low-Impact Products
- Use Less-Hazardous Input Materials
- Minimize Use of Non-Recoverable Input Materials and of Water
- Conserve Energy in Production Operations and Facility Operation
- Improve Process Technology and Practices

**Second Choice (Pollution Prevention):**
**Reuse (Closed-Loop Recycling)**

- Recover Chemicals
- Reuse Water
- Recover Waste Heat

**Third Choice:**
**Recycle Off Site**

- Ensure Safe Transport to Recycling Operation
- Select Environmentally Sound Recycling Technology

**Fourth Choice:**
**Treat and Dispose of Unavoidable Wastes Safely**

- Minimize Volume, Toxicity, and Mobility of Wastes
- Dispose of Safely

Battelle
*. . . Putting Technology To Work*

| | | |
|---|---|---|
| | **U.S. Environmental Protection Agency's Hierarchy of Hazardous Waste Management** | |
| DESIGNED BY J.M. | | |
| DRAWN BY V.S. | PROJECT HUNTERS POINT PROJECT | |
| CHECKED BY L.S. | PROJECT NUMBER G283201-FRIA | DATE 11/95 |

GRIT9.CDR

**Figure 9-1. Waste Management Hierarchy**

detrimental to asphalt quality. Sulfate or metallic iron in the spent grit may cause swelling upon contact with water.

4. When bench-scale testing is performed to design a mix, it is important that the feeder sand/aggregate used in the bench-scale tests be the same as that used in the full-scale operation at the asphalt plant. Otherwise, the bench-scale test will not provide a true representation of the full-scale process. Feeder sand and aggregate are frequently purchased on the open market and characteristics such as trace metal content and particle size, shape, and density can vary significantly from batch to batch.

## 9.3 Cautions

Finally, the following list of cautions is offered for new users who are evaluating recycling spent grit as asphalt aggregate:

1. Soluble and total metal concentrations in the spent sandblasting grit are the basis for whether it will be classified as hazardous, nonhazardous, or special waste. Know your relevant hazardous waste classification definitions, and be aware that certain virgin sandblasting materials, such as metal processing slag, contain elevated metals concentrations from the slagging process. Also, organic priority pollutants, asbestos, tributyltin, radionuclides, and/or other high-hazardous substances should not be present.

2. Extremely fine-grained spent abrasive may mix poorly and/or add little to the structural integrity of the asphaltic concrete. Steel grit should not be recycled into asphaltic concrete because it may expand and lead to cracking upon oxidation.

3. Depending on the region, there may be significant regulatory compliance issues pertaining to grit recycling. These should be clearly understood at the onset of the project, and the participants should make full disclosure of their intent to recycle to both cognizant regulatory agencies and the clients for the paving projects where the grit is to be used.

4. The relative merits of asphalt recycling should be weighed against the merits of some other types of recycling approaches prior to the decision to proceed with asphalt recycling. Certain types of grit are better candidates for recycling into Portland cement, bricks, mortar, or concrete, based on factors such as the chemical composition and particle-size characteristics of the grit, local demand for certain types of construction materials, regulatory preferences, and other factors.

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## APPENDIX A

## COPIES OF PUBLICATIONS RESULTING FROM THE PROJECT

Jeffrey L. Means[1], Karl W. Nehring[1], and Jeffery C. Heath[2]

# ABRASIVE BLAST MATERIAL UTILIZATION IN ASPHALT ROADBED MATERIAL

**REFERENCE:** Means, J. L., Nehring, K. W., and Heath, J. C., "**Abrasive Blast Material Utilization in Asphalt Roadbed Material**," Third International Symposium on Stabilization/Solidification of Hazardous, Radioactive, and Mixed Wastes, ASTM STP 1240, T. Michael Gilliam and Carlton C. Wiles, Eds., American Society for Testing and Materials, Philadelphia, 1995 (in press).

**ABSTRACT:** The State of California has promulgated rules on "California-only" hazardous wastes that offer the potential for some of these wastes to be recycled or reused. Abrasive blast material (ABM) from military and commercial operations such as sandblasting may fall into the category of waste that can be reused. Experiments were conducted on spent sandblasting grit to determine whether the grit could be incorporated into asphalt concrete for use as roadbed material, and a test roadbed was laid to evaluate the long-term stability of the metals found in the grit. Incorporation of the ABM in asphalt helps reduce the mobility of metal contaminants making the material suitable for reuse. The results of the initial characterization, treatability testing, and follow-up measurements of core samples taken from the test roadbed are presented to show that the use of abrasive blast material in asphalt roadbed material is a viable option under the proposed California regulatory standards.

**KEYWORDS:** stabilization, solidification, recycle, asphalt, binders, Toxicity Characteristic Leaching Procedure (TCLP)

## INTRODUCTION

In October, 1989, the State of California issued a policy for "Use in a Manner Constituting Disposal" of certain forms of waste. The policy allows for the recycling of suitable waste materials into construction materials and establishes conditions to ensure that the recycling occurs safely and can be monitored as necessary to prevent abuses. Key conditions of the policy, which applies only to wastes not regulated under the Resource Conservation and Recovery Act (RCRA) (Public Law Number 94–580 U.S.C. 6901 et seq., as amended), are as follows:

1. The recyclable material must be mixed with other materials.

2. After mixing the recycling material with other materials, it must be demonstrated that hazardous constituents failing the California Soluble Threshold Limit Concentration (STLC) criteria of the California Code of Regulations (CCR), Title 22, Chapter 11, Section 66261.24, have chemically reacted so as to be physically inseparable from the resultant product (incorporation of recyclable

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material into asphalt, asphaltic concrete, or concrete is deemed to conform to this criterion). A test of this requirement is to perform the Waste Extraction Test (WET), CCR, Title 22, Chapter 11, Section 66261.24, on the final product. The concentration of the hazardous constituent in the extract must be multiplied by the dilution factor inherent in combining the recyclable material with the other materials. Background levels of hazardous constituents added by ingredients other than the recyclable material may be subtracted from the final WET concentration. The final WET concentration should be less than the applicable STLC.

3. After mixing the recyclable material with other materials, it must be demonstrated that hazardous constituents failing the Total Threshold Limit Concentration (TTLC) criteria of CCR, Title 22, Chapter 11, Section 66261.24, are entrapped so as to prevent significant release of particulate material.

4. After mixing the recyclable material with other substances, it must be demonstrated that the recyclable material adds no hazard to the recycling operation or to the final product.

5. The final product must be available for use by the general public.

This paper describes an ongoing project undertaken for the Naval Civil Engineering Laboratory (NCEL) by Battelle to conduct a recycling demonstration that complies with the California policy for recycling. The spent abrasive blast material (ABM) is treated by stabilization in the asphalt while providing a useful function as aggregate. Data are presented to demonstrate that the recycling of spent ABM into asphalt meets the chemical criteria and that the asphalt-treated grit complies with California Department of Transportation (Caltrans) specifications.

## ANALYTICAL BACKGROUND

The subject ABM is sandblasting grit that has been the subject of an ongoing investigation by the U.S. Navy and Battelle Memorial Institute for several years. The grit currently resides in two piles deposited on the industrial landfill area of the Hunter's Point Annex (HPA) shipyard: (1) an approximately 2,400-$yd^3$ (1,800-$m^3$) pile of raw spent sandblasting grit; and (2) an approximately 800-$yd^3$ (600-$m^3$) pile of spent sandblasting grit that was treated with small amounts of fly ash, sodium hydrosulfide, and water in December, 1989. The HPA shipyard is on San Francisco Bay, South of San Francisco.

The measured soluble lead (Pb) and copper (Cu) levels of the two grit piles indicate that the grits are considered hazardous by California State Code Title 22 but not hazardous by U.S. Environmental Protection Agency (EPA) toxicity characteristic regulations (40 CFR 261.24). A series of analyses were performed to determine the total and leachable metal contents of the ABM. The total acid-digestible metals content was determined for the 17 metals listed in the California Assessment Manual (CAM) for the 17 California Assessment Manual (CAM) plus hexavalent chromium to allow comparison of total metals to the California TTLC requirements (California Title 22). California Waste Extraction Test (WET) soluble metal content was determined for metals having a total TTLC content above the STLC limits. The Extraction Procedure Toxicity (EP-Tox, EPA solid waste SW-846 method 1310) and Toxicity Characteristic Leaching Procedure (TCLP, EPA solid waste SW-846 method 1311) data were collected for the 8 RCRA metals. Organic priority pollutant analyses were performed on both raw grit and the sulfide-treated grit. An analysis was performed to determine the concentration of organic tin compounds due to the use of butyl-tin antifouling compounds in paints used on ships.

The results of all of the analyses are presented in detail in Means [1],[2]. For the purposes of this paper, the focus will be on metals, comparing the "before" data on metals for the grit with the "after" data following the S/S treatment with asphalt.

**Metal Compositional Data**

A summary of the total metals concentration data is provided in Table 1 for both the raw grit and the sulfide-treated grit. Copper, lead, and zinc (shown in bold in the table) are the primary metal contaminants. Traces of several other metals also are present. Comparison with the TTLC criteria in the right-hand column of Table 1 shows that the HPA grit is *not* TTLC-hazardous.

TABLE 1--Mean metal contents (TTLC analysis) for raw and sulfide-treated grit samples.

| | Total Metal Concentration (mg/kg) | | |
|---|---|---|---|
| Element | Raw Grit | Sulfide-Treated Grit | TTLC* |
| **Cu** | **1,832** | **1,300** | **2,500** |
| **Pb** | **204** | **160** | **1,000** |
| Sb | 11 | <20 | 500 |
| As | 5.4 | 1.5 | 500 |
| Ba | 246 | 160 | 10,000 |
| Be | 0.2 | <0.6 | 75 |
| Cd | <0.5 | <1 | 100 |
| Cr (Total) | 99.8 | 34 | 2,500 |
| Cr(VI) | 11.2 | <1 | 500 |
| Co | 8.2 | 9 | 8,000 |
| Hg | <0.4 | <0.1 | 20 |
| Mo | 11.6 | <10 | 3,500 |
| Ni | 79 | 54 | 2,000 |
| Se | <0.5 | <0.1 | 100 |
| Ag | 1.3 | <1.0 | 500 |
| Tl | 5.0 | <6.0 | 700 |
| V | 22.1 | <21.3 | 2,400 |
| Zn | 1,062 | 960 | 5,000 |

*From California Code of Regulations, Title 22, Section 66261.24.
TTLC = total threshold limit concentration.

A similar summary of the WET-soluble metals concentration data is provided in Table 2, again for both the raw grit and the sulfide-treated grit. Copper and lead (bolded in the table) exceed their respective STLCs for both the raw grit and the sulfide-treated grit. Therefore, both grits are considered hazardous in California. The STLC Cu and Pb contents of the sulfide-treated grit were significantly lower than the STLC Cu and Pb contents of the raw grit [1],[2].

Table 3 summarizes the TCLP and EP Toxicity Characteristic leaching data for the raw grit and sulfide-treated grit. None of the metals exceeds its TCLP threshold; therefore, the waste is neither an EPA nor a RCRA hazardous waste. It is considered hazardous only by virtue of STLC Cu and Pb exceedances and is referred to as a California-only hazardous waste.

Table 2--Mean wet-soluble metal contents (STLC analysis) for raw and sulfide-treated grit samples.

| Element | Soluble Metal Concentration (mg/L) | | |
|---|---|---|---|
| | Raw Grit | Sulfide-Treated Grit | STLC* |
| **Cu** | ****144** | ****55.5** | **25** |
| **Pb** | ****19** | ****11.1** | **5** |
| Sb | NA | <1.0 | 15 |
| As | 0.06 | 0.11 | 5 |
| Ba | 6.8 | 2.3 | 100 |
| Be | <0.03 | <0.03 | 0.75 |
| Cd | <0.06 | <0.05 | 1 |
| Cr (Total) | 2.0 | 1.4 | 560 |
| Cr(VI) | <1.0 | <1.0 | 5 |
| Co | <0.2 | <0.2 | 80 |
| Hg | <0.01 | <0.01 | 0.2 |
| Mo | <1.0 | <1.0 | 350 |
| Ni | 1.0 | 1.2 | 20 |
| Se | <0.01 | <0.01 | 1 |
| Ag | <0.05 | <0.05 | 5 |
| Tl | <0.3 | <0.3 | 7 |
| V | <1.0 | <1.0 | 24 |
| Zn | 146 | 89 | 250 |

*From California Code of Regulations, Title 22, Section 66699.
**Exceeds STLC criterion.
STLC = Soluble Threshold Limit Concentration.
NA = Not Analyzed.

TABLE 3--Mean TCLP- and EP Tox-soluble metal contents for raw and sulfide-treated grit samples.

| Element | Soluble Metal Concentration (mg/L) | | |
|---|---|---|---|
| | Raw Grit | Sulfide-Treated Grit | TCLP Limit* |
| Pb | *1.11 | 0.5 | 5 |
| As | 0.05 | 0.5 | 5 |
| Ba | 5 | 5 | 100 |
| Cd | 0.05 | 0.1 | 1 |
| Cr | 0.5 | 0.5 | 5 |
| Hg | 0.02 | 0.02 | 0.2 |
| Se | 0.05 | 0.05 | 1 |
| Ag | 0.05 | 0.5 | 5 |

*The EP-Tox value is 0.6 mg/L vs. an EP-Tox limit of 5 mg/L.

## BENCH-SCALE TREATABILITY TESTS

Bench-scale treatability tests were performed to evaluate the quality of the asphalt produced with HPA grit as an additive and also to determine the optimal mix of ingredients (bitumen, aggregate, and grit) in the asphalt. Asphalt mixtures containing 46% and 7% raw and sulfide-treated sandblasting grit were tested in the bench-scale tests. For the sake of simplicity, the asphalt-treated grit mixtures will be referred to as 46% (raw and sulfide-treated) and 7% mix (raw and sulfide-treated).

Three chemical leaching tests were conducted: the California WET, to determine whether the cured asphalt-treated grit mixtures met the California Soluble Threshold Limit Concentration (STLC) criterion for heavy metals; the TTLC test, to verify that the cured asphalt-treated grit mixture adhered to the TTLC criterion; and the TCLP.

### Chemical Leach Tests

The results of the chemical leach tests for the 46% and 7% mixes are presented in Tables 4 and 5, respectively. As expected, the TTLC Pb and Cu levels for both mixes were reduced in proportion to the dilution of the grit with aggregate and asphalt. In the case of the 46% mix, the STLC for Pb was below regulatory levels; however, the STLC Cu concentration was about 1.5 times higher than the regulatory level of 25 mg/L. STLC Pb and Cu levels for the 7% mix were below the regulatory limits.

In contrast to the TTLC Pb and Cu levels, the STLC Pb and Cu levels for the mixes were reduced in greater proportion to the dilution of the grit with aggregate and asphalt. Reduction of leachable metal levels indicates that Pb and Cu in the grit were immobilized to a certain extent by the asphalt treatment. The TCLP levels for Pb and Cr for treated and raw grit were less than the regulatory levels even before the grit was recycled into the asphalt-treated grit mixture. The TCLP levels for Pb and Cr therefore would meet regulatory limits after the grit is recycled into asphalt concrete.

TABLE 4--Chemical leach test (46% mix).

| | TTLC (mg/kg) | | STLC (mg/L) | | TCLP (mg/L) | |
|---|---|---|---|---|---|---|
| | Pb | Cu | Pb | Cu | Pb | Cr (Total) |
| Untreated Grit | | | | | | |
| Before Recycling into Asphalt | 316 | 2,180 | 12.8 | 140 | 1.5 | 0.22 |
| After Recycling into Asphalt | 174 | 974 | 0.44 | 38.5 | 0.18 | 0.011 |
| Treated Grit | | | | | | |
| Before Recycling into Asphalt | 147 | 1,230 | 13.2 | 78.2 | 1.7 | 0.21 |
| After Recycling into Asphalt | 118 | 985 | 0.58 | 44.5 | 0.43 | 0.041 |

TTLC Limits (mg/kg): Pb = 1,000; Cu = 2,500.
STLC Limits (mg/L): Pb = 5; Cu = 25.
TCLP Limits (mg/L): Pb = 5; Cr = 5.

### Treatability Tests

The results of the treatability tests showed that the use of sandblasting grit as possible feed material in asphalt concrete for road pavement is a possible and viable option. Physical tests have shown that the Caltrans or Asphalt Institute test limit criteria can be met by selecting the appropriate

TABLE 5--Chemical leach test (7% mix).

| | Chemical Leach Test (7% Mix) | | | | | |
|---|---|---|---|---|---|---|
| | TTLC (mg/kg) | | STLC (mg/L) | | TCLP (mg/L) | |
| | Pb | Cu | Pb | Cu | Pb | Cr (Total) |
| Hunter Point Untreated Grit | | | | | | |
| Before Recycling into Asphalt | 316 | 2,180 | 12.8 | 140 | 1.5 | 0.22 |
| After Recycling into Asphalt | | | | | | |
| Uncrushed Pellet | 18 | 118 | 0.076 | 2.8 | | |
| Crushed Pellet | 31 | 179 | <0.05 | 4.4 | | |
| Hunter Point Treated Grit | | | | | | |
| Before Recycling into Asphalt | 118 | 1,230 | 13.2 | 78.2 | 1.7 | 0.21 |
| After Recycling into Asphalt | | | | | | |
| Uncrushed Pellet | 21 | 109 | 0.18 | 3.9 | | |
| Crushed Pellet | 19 | 132 | 0.084 | 5.8 | | |

TTLC Limits (mg/kg); Pb = 1,000; Cu = 2,500.
STLC Limits (mg/L); Pb = 5; Cu = 25.
TCLP Limits (mg/L); Pb = 5; Cr = 5.

asphalt/aggregate/grit mixtures and by varying the asphalt content in the mixture. Table 6 presents the results of the physical tests. The California Department of Toxic Substances Control (DTSC) regulatory chemical leach test requirements (CCR, Title 22, Chapter 11, Section 66261.24) also can be satisfied through dilution by selecting the appropriate asphalt/aggregate/grit mix. The 7% grit mix passes the chemical criteria limits by a margin that allows for some heterogeneity in the composition of the asphalt-treated grit.

## EXCAVATION/TREATMENT/REPLACEMENT PROCEDURES

The results of the treatability testing demonstrated that the asphalt samples containing the spent ABM met regulatory requirements in terms of both leaching potential and physical properties. Based on the successful treatability testing, the decision was made to conduct a pilot-scale test of the asphalt that would involve laying test strips of asphalt incorporating the spent ABM in a stretch of roadway so that the long-term performance of the asphalt could be assessed under conditions of actual use.

### Grit Excavation at HPA and Transport to the Asphalt Plant

The loading and transportation of grit from HPA to the asphalt plant (Reed and Graham, Inc. in San Jose) took place on Wednesday, November 20, 1991. An equipment company was contracted to provide a water truck and operator to wet down the work area and minimize dust emissions during grit excavation and the movement of heavy equipment at HPA.

TABLE 6--Physical properties tests (Hveem Test) for 46% and 7% mix.

| Sand Blasting Grit Content | 46% | | 7% | | | | | | Test Limit Criteria (Medium Traffic) |
|---|---|---|---|---|---|---|---|---|---|
| | Raw | Sulfide-Treated | Raw | | | Sulfide-Treated | | | |
| Asphalt Content (%) | 5.5 | 5.5 | 5.3 | 5.8 | 6.3 | 5.3 | 5.8 | 6.3 | |
| Stabilometer | 31 | 46 | 42 | 38 | 31 | 36 | 34 | 29 | 35 (min)* |
| Cohesiometer | 379 | 374 | 369 | -- | -- | 372 | -- | -- | 50 (min)** |
| % Voids | 3.3 | 7.6 | -- | -- | -- | -- | -- | -- | 4 (min) - 8 (max)*** |

* Caltrans Criteria for Medium-traffic Applications

** Asphalt Institute (1962) Criteria

*** Asphalt Institute (1962) Criteria; minimum value for Hveem Test, maximum value as listed for Marshall Test. Note that there is no maximum % voids value for the Hveem Test in the Asphalt Institute (1962) criteria.

The grit was loaded nearly to capacity into four 2.5-yd$^3$-capacity (1.9-m$^3$-capacity) material bins with closeable lids, two each for the untreated and treated grit. A section of tarpaulin approximately 10 ft by 10 ft (3 m by 3 m) was removed from each of the two grit piles. Grit material was excavated and loaded into the material bins with a backhoe. The backhoe had an enclosed cab that protected the operator from fugitive dust. After the grit for the field demonstration was satisfactorily loaded into the bins and the sampling and monitoring was completed, the tarpaulins were resecured over the grit piles and the seams heat-sealed to prevent infiltration of rain.

## Screening Operation at the Asphalt Hot Plant

The screening operation was conducted on Friday, November 22, 1991. Personnel involved in grit handling wore coveralls, hard hats, gloves, and half-face respirators. The screen was a conveyor-type feed with a feed hopper at one end and a ⅜-in. (9.5-mm) vibrating screen at the other end. A material bin was chained into the bucket of a front-end loader and emptied into the feed hopper. The empty material bin was then taken to the opposite end of the screen and placed under a shoot through which the screened material would pass. The oversized reject material was vibrated off the top of the screen and collected in the bucket of the front-end loader. The reject was rescreened at least twice to ensure that as much grit as possible passed through the screen. The material that did not pass through the screen was placed into 55-gal (208-L) waste drums, and, after California EPA approval, was transported back to HPA and stored in Building 810 pending further processing of sandblasting grit during full-scale production.

Battelle conducted air monitoring tests during the screening operation. The tests were designed to assess the potential health impacts of dust generated by various activities associated with the asphalt recycling process. Tests were included to measure the background levels of windborne dust plus ambient concentrations of Cu, Pb, and Cr. These levels were compared to the concentrations from the process being monitored. Personal samplers also were included to assess any potential for equipment operators to be exposed. A portable meteorological monitoring instrument was used to collect site-specific wind speed and direction during the tests.

Only the personal samplers showed any significant dust concentrations. The highest total dust concentration was 0.42 mg/m$^3$. Total dust concentrations of 0.11 mg/m$^3$ or less were typical. The highest concentrations of dust-borne Cr, Cu, and Pb were 0.0017, 0.0078, and <0.011 mg/m$^3$, respectively. For comparison, current guideline values of Threshold Limit Values for particulate (not otherwise specified), insoluble chromium (VI) compounds, copper oxide fume, and lead particulate are 10 mg/m$^3$, 0.01 mg/m$^3$, 0.2 mg/m$^3$, 0.1 mg/m$^3$, respectively [3],[4]. Wind speeds during the testing ranged from 1.8 to 2.5 mph (2.9 to 4.8 km/hr).

The results for Cr, Cu, and Pb indicated that concentrations for Pb, which is an ambient criteria pollutant, were consistently below the detection limits of the sampling method. Therefore, exposure of workers or the surrounding population to Pb was insignificant under the conditions as tested.

Cr was detected in all five of the filters analyzed. However, there was no difference between any of the downwind samples and the upwind samples, indicating no increases in the Cr concentrations relative to the ambient air Cr concentrations in that area.

Cu was the only metal that showed an increase in one of the downwind samples relative to the upwind samples. It was unusual that the downwind sampler at a closer distance from the screening process had a significantly lower Cu concentration than the sampler at a greater distance.

## Asphalt Production at the Asphalt Plant

The field demonstration was conducted on Saturday, November 23, 1991. The asphalt concrete containing sandblasting grit was produced at the Reed and Graham hot plant starting around 8:00 a.m. Saturday morning and ending at approximately 12:30 p.m. After each batch was produced, the asphalt concrete was transported immediately to HPA for paving. Three different batches of asphalt concrete test material were produced:

- A control batch, containing only normal, graded aggregate and no sandblasting grit,
- Asphalt concrete containing untreated sandblasting grit from HPA, and
- Asphalt concrete containing sulfide-treated sandblasting grit from HPA.

Approximately 30 tons (27,000 kg) of test asphalt concrete were prepared per batch. The batches were shipped to HPA in two 15-ton-capacity (13,600-kg-capacity) end-dump trucks. After the two trucks were loaded, the load was covered with a tarpaulin prior to transportation. The hot plant was then emptied of any excess material remaining in the mixer, approximately 10 tons (9,100 kg) of excess material per batch. The excess material containing sandblasting grit was placed in two piles in an isolated part of the plant yard, and was chemically analyzed for total and WET-soluble metals to determine if the grit could be crushed and recycled back into aggregate in a future paving application.

Approximately 1.5 tons (1,400 kg) of sandblasting grit was incorporated into each of the two 30-ton (27,000-kg) batches of test asphalt, therefore corresponding to an average grit concentration of approximately 5% by weight. The concentration was actually slightly less than 5% because some of the grit was incorporated into the 10 tons (9,100 kg) of excess grit as noted above. An average grit loading of 7% by weight was the target value; it proved difficult to accurately achieve this value during these short production runs, because the asphalt plant is scaled-up to produce hundreds of tons of asphalt per hour. During a longer production run or during normal full-scale processing, a 7% grit concentration in the asphalt concrete would not be difficult to achieve after an initial calibration period.

Each batch of asphalt concrete was sampled by collecting approximately 5 gal (19 L) of loose asphalt material at the hot plant immediately after production. The loose material was later pressed into test pellets and cores under simulated paving compaction conditions, to be used for chemical and physical properties measurements.

Air monitoring for hydrogen sulfide also was conducted during asphalt production. Hydrogen sulfide was monitored continuously at ground level by two different individuals during the processing of the sulfide-treated grit. At no time was there any hydrogen sulfide detected at the hot plant. The electrochemical sensor hydrogen sulfide detector had a limit of detection of 0.1 ppm.

Each 30-ton (27,000-kg) batch of asphalt concrete provided sufficient material to pave approximately 2,400 ft$^2$ (220 m$^2$) of roadway at an average thickness of 2 in. (5.1 cm). Each batch produced for this demonstration was used to pave two different test strips at HPA, one larger strip for long-term monitoring and one smaller strip for a road-grinding air emissions test currently scheduled for later in 1992.

## Roadway Application of the Asphalt Test Strips

The asphalt concrete test material was successfully transported to HPA without incident and was applied to six different test strips at HPA, as follows:

- Two strips containing standard production (control) asphalt concrete,
- Two strips containing untreated sandblasting grit, and
- Two strips containing sulfide-treated sandblasting grit.

Asphalt concrete was applied to two different stretches of road at HPA. Three of the six test strips (one each of the asphalt concrete control, untreated grit, and sulfide-treated grit) were laid for long-term physical and chemical testing. These strips were laid side-by-side extending the width of the road. They measure approximately 30 ft by 50 ft (9 m by 50 m) in area by 2 in. (5.1 cm) deep. These test strips were sampled for physical and chemical properties measurements several days after application, resampled in June, 1993, and will be resampled at intervals for the next several years.

The second series of three test strips was laid in series on the northern side of the road. They measure approximately 18 ft wide (5.5 m wide) and 50 ft long (15 m long) by 2 to 2.5 in. deep (5.1 to 6.4 cm deep). Each test plot was prepared for application in the same way normal roads are prepared for resurfacing. The crew supervisor inspected each test plot for any failures which might exist and had any vegetation and dirt removed from the test plot areas. After the paving operation, the test strips were inspected by the field engineer for smoothness and uniformity. After all rolling was completed, fog seal was applied to all the test strips.

A road-grinding operation on these strips was later conducted to measure the release of fugitive dust and contaminants. The strips were ground in their entirety to simulate an asphalt-grinding operation preceding an asphalt overlay. Air monitoring data were collected at both short-range distances to simulate occupational exposure and longer-range distances to address possible nonoccupational exposure. Results of this testing are not yet available, but will be published at a later date.

## LONG-TERM TESTING OF THE PILOT-SCALE TEST STRIPS

In addition to the loose asphalt concrete samples described above, asphalt core samples were collected from the long-term test strips several days after the asphalt concrete was applied. Five undisturbed core samples were collected (five cores each of control, untreated, and sulfide-treated) from each long-term test strip. A portable drilling machine with a water-cooled, diamond-tipped coring bit was used for core collection.

## Physical and Chemical Analyses

The asphalt concrete test samples were analyzed for the following physical and chemical parameters in order to assess compliance with Caltrans and DTSC sandblasting grit recycling criteria:

- Stabilometer value
- Cohesiometer value
- % voids
- WET-soluble Cu and Pb
- Total Cu and Pb.

The three different types of asphalt were analyzed for total and WET-soluble Cu and Pb content to determine compliance with DTSC recycling criteria and to calculate the average grit composition of the asphalt production runs containing untreated and treated grit. The analytical data are presented in Table 7. All of the total and WET-soluble Cu and Pb contents are well below their respective Title 22 TTLC and STLC values (see Tables 1 and 2), and therefore show compliance with proposed California EPA Use Constituting Disposal (UCD) policy.

Further, the total metals data in Table 7 were evaluated in comparison with the average total metals data in Table 1 as an approach to calculating the weight percent of grit that was added to the untreated and treated grit test strips. Assuming grit concentration was approximately 5%, or slightly less based on the fact that approximately 1.5 tons (1,400 kg) of grit was incorporated into 30 tons (27,000 kg) or slightly more of asphalt concrete, the weight percent grit content of the untreated or treated asphalt, A, was calculated from the following dilution calculation:

$$\frac{[X - Y]}{Z} * 100 = A$$

where

X = the total Cu or Pb concentration in the asphalt concrete test specimen (pellet or core, untreated or treated) from Table 7.

Y = the total Cu and Pb concentration in the control asphalt concrete test specimen (pellet or core, untreated or treated) from Table 7.

Z = the mean total Cu or Pb concentration in the untreated or treated grit from Table 1.

The results of these dilution calculations show that the average grit concentration in the untreated asphalt concrete was 4.5 ± 1.6 wt% and in the treated asphalt concrete was 5.0 ± 1.4 wt%. These values provide independent confirmation of the values estimated from the mass loading of sandblasting grit with the other asphalt concrete ingredients.

TABLE 7--Metals data on asphalt concrete test specimens.

| Sample ID | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| | Cu | Pb | Cu | Pb |
| Control Asphalt Core | 21 | 3.0 | 0.088 | 0.050 |
| Control Lab Pellet | 16 | 3.0 | 0.034 | 0.050 |
| Untreated Asphalt Core | 93 | 17 | 1.2 | 0.056 |
| Untreated Lab Pellet | 74 | 11 | 0.098 | 0.050 |
| Loose Untreated | 110 | 20 | 1.8 | 0.050 |
| Treated Asphalt Core | 62 | 10 | 0.69 | 0.097 |
| Treated Lab Pellet | 93 | 13 | 0.20 | 0.050 |
| Loose Treated | 76 | 9.8 | 0.42 | 0.07 |

**Metals Analysis of Asphalt Cores**

The three asphalt test strips were resampled in June, 1993, with 27 undisturbed core samples collected (nine cores each of control, untreated, and sulfide-treated) from each of the three long-term test strips. A portable drilling machine with a water-cooled, diamond-tipped coring bit was used for core collection.

The asphalt concrete test samples were analyzed for the following physical and chemical parameters to assess compliance with Caltrans specifications and DTSC sandblasting grit recycling criteria: WET-soluble Cu and Pb; Total Cu and Pb; Stabilometer value; Cohesiometer value; and % voids and other physical characteristics relating to long-term durability. Results of the metals analyses and physical tests are presented in Tables 8 and 9.

Table 8--Results of metals analysis on long-term test strips, June, 1993 sampling.

| Sample | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| | Cu | Pb | Cu | Pb |
| Untreated #1 | 70 | 18 | 0.69 | 0.14 |
| Untreated #2 | 98 | 19 | 1.3 | 0.088 |
| Untreated #3 | 90 | 22 | 0.21 | 0.23 |
| Sulfide-Treated #1 | 47 | 12 | 0.88 | 0.073 |
| Sulfide-Treated #2 | 85 | 14 | 0.44 | 0.18 |
| Sulfide-Treated #3 | 25 | 11 | 0.49 | 0.068 |
| Control #1 | 14 | 7.6 | 0.046 | 0.069 |
| Control #2 | 17 | 8.8 | 0.067 | 0.073 |
| Control #3 | 14 | 6.3 | 0.19 | 0.097 |

Nine asphalt core samples, three each from the untreated, sulfide-treated, and control test strips, were analyzed for STLC and TTLC Cu and Pb. The results (Table 8) indicate very similar metals concentrations in the test strips based on the June 1993 sampling as were present during the November, 1991 sampling (see Table 7). There is no evidence of reduction in the concentration of either metal and therefore no evidence of metals leaching since the asphalt test strips were laid in November, 1991. Results for the physical properties tests for standard asphalt-concrete (control), asphalt concrete containing untreated grit, and asphalt concrete containing treated grit are presented in Table 9. Several observations may be drawn from the data. First, the percent void values were lower than normally encountered. They probably are lower because of the high temperatures upon arrival at HPA and the prompt and thorough compaction through rolling. Such low percent voids values typically are associated with high-integrity asphalt and would not be viewed negatively but are not always achieved in the commercial paving industry because more cooling usually takes place between asphalt production and compaction.

Second, there are several instances of relatively low stabilometer values for several of the samples, namely, control samples #2 and #3, untreated sample #3, and all three treated samples. These relatively low stabilometer values are not associated with the presence of sandblasting grit as an additive because two out of three control samples are low. Instead, the low stabilometer values have a direct correlation with percent oil by weight of aggregate content. Those samples having high oil contents (>6.0%) also are the ones that have low stabilometer values (<35) and exhibited strong flushing and/or pumping characteristics upon compaction. Therefore, it appears that the test mixes that were produced from these test strips were slightly oily, which is not surprising given the fact that the batch sizes were so small.

Table 9--Physical asphalt concrete tests, June, 1993 sampling.

| Test Performed | Control #1 | Control #2 | Control #3 | Untreated #1 | Untreated #2 | Untreated #3 | Treated #1 | Treated #2 | Treated #3 | Test Limit Criteria |
|---|---|---|---|---|---|---|---|---|---|---|
| Percent oil by weight of aggregate | 5.8 | 6.2 | 6.1 | 5.9 | 5.4 | 6.0 | 6.1 | 6.6 | 6.2 | |
| Percent oil by weight of mix | 5.5 | 5.8 | 5.8 | 5.6 | 5.2 | 5.6 | 5.7 | 6.2 | 5.8 | |
| Maximum | 154.5 | 153.7 | 154.6 | 155.0 | 155.6 | 155.2 | 154.7 | 153.7 | 154.1 | |
| Laboratory-Compacted Unit Weight, lb/ft$^3$ (kg/m$^3$) | 150.1 (1.928) | 150.5 (1.933) | 151.2 (1.942) | 150.6 (1.934) | 150.8 (1.937) | 150.8 (1.937) | 150.3 (1.931) | 151.1 (1.941) | 151.8 (1.950) | |
| Percent Voids | 2.8 | 2.1 | 2.2 | 2.8 | 3.1 | 2.8 | 2.8 | 1.7 | 1.5 | 4 (min)(-)8 (max)* |
| Hveem Stabilometer Value | 37 | 22 | 32 | 41 | 35 | 32 | 32 | 21 | 17 | 35 (min)** |
| Compacted appearance of Hveem specimens | moderate flushing | flushing and pumping | flushing | moderate flushing | very slight flushing | moderate flushing | flushing | flushing and pumping | flushing and pumping | |
| Swell (CA 305) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.030 In (max) |
| Cohesiometer, lb/ft$^3$ (kg/m$^3$)(CA 306) | 542 (6.96) | 343 (4.40) | 503 (6.46) | 505 (6.49) | 455 (5.84) | 480 (6.17) | 405 (5.20) | 377 (4.84) | 155 (1.99) | 50 (min)*** |

* Asphalt Institute (1962 criteria; minimum value for Hveem Test, maximum value as listed for Marshall Test. Note that there is no maximum % voids, value for the Hveem Test in the Asphalt Institute (1962) criteria (P.O. Box 14052, Lexington, KY 40512-4052, Tel. 606/288-4060, Fax 606/288-4999).

** Caltrans criteria for medium-traffic applications.

*** Asphalt Institute (1962) criteria (P.O. Box 14052, Lexington, KY 40512-4052, Tel. 606/288-4060, Fax 606/288-4999).

It is difficult to achieve precise mix formulations with large full-scale asphalt production equipment when only 30 tons (27,000 kg) of asphalt are produced per batch. Mix design would be much easier to achieve during full-scale production, thus eliminating the high oil contents.

## Compliance With California STLC Criteria

In order to demonstrate that the asphalt meets California STLC requirements, calculations can be performed to determine compliance after subtracting the background contribution and correcting for the effect of dilution. Table 10 presents the results of the calculations for Pb in asphalt strips that contained untreated grit. The average WET (leachable) Pb content of the untreated grit was 19 mg/L, compared to an STLC of 5 mg/L. Therefore, the asphalt binder ingredients would need to immobilize the Pb by a factor of approximately four to bring the WET Pb content of the spent ABM in the asphalt concrete to below 5 mg/L. Based on analysis of the core samples, the average WET Pb content of the ABM-containing asphalt concrete was 0.13 mg/L, versus 0.07 mg/L for control asphalt specimens containing the same aggregate and oil contents, but no ABM, thus indicating a WET Pb content of 0.06 mg/L attributable to the ABM component of the asphalt. Asphalt concrete was 5.0%, indicating a dilution factor of 20 which, when multiplied by the background-corrected WET Pb content of the asphalt concrete, yields 1.2 mg/L Pb. This value is well below the STLC criterion for Pb, 5 mg/L, thus indicating compliance with the criterion. Tables 11, 12, and 13 present similar calculations for Cu and Pb for asphalt concrete samples containing both treated and untreated grit. In all cases, the STLC criteria have been met.

TABLE 10--Calculations for Pb in asphalt test strips containing untreated grit.

| | |
|---|---|
| Mean Total Pb Content of Grit | 204 mg/kg |
| Mean WET Pb Content of Grit | 19 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.13 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A-B) | 0.06 mg/L |
| D) Dilution Factor-Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 1.2 mg/L |
| F) STLC for Pb | 5.0 mg/L |

## CONCLUSIONS

The use of ABM in asphalt roadbed material has been shown to be a viable option under the proposed California regulatory standards. The ABM provides value as aggregate in the asphalt while the asphalt assists in immobilizing metal contaminants. The merits of recycling versus some other option should be evaluated on a case-by-case basis. This paper has considered only the chemical and

TABLE 11--Calculations for Cu in asphalt test strips containing untreated grit.

| | |
|---|---|
| Mean Total Cu Content of Grit | 1,832 mg/kg |
| Mean WET Cu Content of Grit | 144 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.85 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A-B) | 0.75 mg/L |
| D) Dilution Factor-Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 15 mg/L |
| F) STLC for Cu | 25 mg/L |

TABLE 12--Calculations for Pb in asphalt test strips containing sulfide-treated grit.

| | |
|---|---|
| Mean Total Pb Content of Grit | 160 mg/kg |
| Mean WET Pb Content of Grit | 11.1 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A-B) | 0.03 mg/L |
| D) Dilution Factor Sulfide-Treated Test Strips | 22 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 0.66 mg/L |
| F) STLC for Pb | 5.0 mg/L |

physical analyses with regard to stated California regulations. Other considerations, such as federal regulations and cost, also need to be considered in the decision to recycle spent ABM into asphalt roadbed material. However, the recycling option is higher in the hierarchy of hazardous waste management than disposal with or without treatment options. Further, waste minimization credit may be given to the generator of the spent ABM because it is not manifested to the asphalt plant for recycling. With recycling, valuable landfill space can be reserved for higher-level hazardous wastes. The spent ABM was found to contain relatively low metal concentrations and to pose negligible risk.

TABLE 13--Calculations for Cu in asphalt test strips containing sulfide-treated grit.

| | |
|---|---|
| Mean Total Cu Content of Grit | 1,300 mg/kg |
| Mean WET Cu Content of Grit | 55.5 mg/L |
| A) WET Pb Content of Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.63 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Pb Content of Asphalt Test Strips (A-B) | 0.53 mg/L |
| D) Dilution Factor Sulfide-Treated Test Strips | 22 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 11.7 mg/L |
| F) STLC for Pb | 25 mg/L |

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# Laboratory Treatment and Field Demonstration Lessons Learned from a Waste Stabilization Project

**REFERENCE:** Means, J. L., Heath, J. C., and McLaughlin, W. J., **"Laboratory Treatment and Field Demonstration Lessons Learned from a Waste Stabilization Project,"** *Stabilization and Solidification of Hazardous, Radioactive, and Mixed Wastes, 2nd Volume, ASTM STP 1123,* T. M. Gilliam and C. C. Wiles, Eds., American Society for Testing and Materials, Philadelphia, 1992, pp. 466–478.

**ABSTRACT:** For a ten-year period, 1976 to 1986, the U.S. Navy leased most of its naval station, Treasure Island, Hunters Point Annex (HPA), to Triple A Machine Shop, which operated the station as a commercial ship repair facility. Triple A generated waste sandblasting grit contaminated with toxic heavy metals (i.e., lead and copper). The grit accumulated in a 2300-$m^3$ (3000-$yd^3$) pile. This three-phase study evaluated the effectiveness of a sulfide-based chemical fixation process in rendering the grit nonhazardous under U.S. Environmental Protection Agency and State of California hazardous waste rules and regulations.

Two significant lessons resulted from the study. First, the unsatisfactory degree of stabilization of the lead and copper during the field demonstration was a direct result of their encapsulation in organic coatings (antifouling agents, pigments, etc.). Understanding the physicochemical form of the contaminant is as important as knowing the type and amount of the contaminant present. Second, sulfide-based formulations used in the laboratory enhanced the degree of stabilization over that which occurred in the field. During laboratory treatability studies, it is important to cure the waste in a setting that simulates the conditions that will be encountered in the field.

Sulfide binders, as shown in this study, have a role in stabilization/solidification where conventional technologies are unable to meet performance criteria.

**KEY WORDS:** stabilization, solidification, lead, copper, sandblasting grit, leaching data, sampling, statistical analysis, treatability

From 1976 to 1986, the U.S. Navy leased most of its naval station, Treasure Island, Hunters Point Annex (HPA), to Triple A Machine Shop, which operated it as a commercial ship repair facility. Triple A's shipyard corrosion control operations generated waste sandblasting grit, which was deposited in the industrial landfill area of the shipyard. An approximately 2300-$m^3$ (3000-$yd^3$) pile of waste sandblasting grit present at the facility is the subject of this study.

The overall objective of this project was to evaluate the effectiveness of a sulfide-based chemical fixation process in rendering the sandblasting grit contaminated with toxic heavy metals nonhazardous under U.S. Environmental Protection Agency (EPA) and State of California hazardous waste rules and regulations. The project was divided into three phases. Phase I was a sampling and analysis activity to identify the target contaminants. Phase II was a laboratory

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demonstration activity to develop and verify the effectiveness and suitability of a chemical stabilization process prior to treating the 2300 $m^3$ of grit. Phase III was the field treatment demonstration of the bench-scale-tested treatment technology on the 2300-$m^3$ waste pile. After treatment, the treated grit was to be disposed of in a municipal landfill as nonhazardous waste.

### Phase I: Sampling and Analysis

#### *Sampling*

The field site consists of an accumulated pile of sandblasting grit situated on a cleared soil area. The pile is approximately 18 m (20 yd) wide by 41 m (45 yd) long, in the approximate shape of a kidney bean, and is about 3 m (9 ft) high with a relatively flat top. The pile has been covered with a tarpaulin to reduce dust emissions and the infiltration of precipitation through the pile.

Because of possible variations in metal concentrations in different parts of the pile, samples were collected from random locations and as a function of depth. In November 1988 the pile was gridded into equal surface areas by marking a coordinate every 2 m (6 ft). This resulted in 208 grids having surface areas of approximately 3 $m^2$ (36 $ft^2$) each (Fig. 1). The grid areas were numbered consecutively so that sample locations could be referenced. Then sample grid numbers were selected from a random number table for each sampling location. Twenty-four different samples were collected along with two blind replicates. Eight samples were collected at each of three depth intervals: (*a*) 0 to 1 m (0 to 3 ft, avoiding the top 8 cm or 3 in.); (*b*) 1 to 2 m (3 to 6 ft); and (*c*) 2 to 3 m (6 to 9 ft).

Samples were collected using a stainless steel shovel or sand auger, depending on depth. A portion of each sample was archived for possible future use. Samples were split in the field using a riffle-type splitter, placed in precleaned polyethylene (I-Chem Corp.) bottles, and immediately shipped under chain of custody to the appropriate laboratory for analysis or storage. The splitter, sampling devices, and mixing tray were cleaned between each sample. A field quality control (QC) blank was collected using clean sand to verify that cross-contamination was not occurring. Permanent field notebooks were maintained with proper documentation.

#### *Analysis of Untreated Samples*

As mentioned above, 24 different samples (plus two blind replicates) from three different depth horizons were collected. Portions of selected untreated samples were analyzed for total *California Assessment Manual* (CAM) and soluble (Waste Extraction Test leaching test) metals using State of California protocols. Selected samples were also analyzed using the EP Tox (U.S. EPA) leaching methodology. All California tests were conducted by a California-certified analytical laboratory.

The results of the total metal analyses are provided in Tables 1 and 2 and lead to the following conclusions: (*a*) with one exception, only copper and lead were present in concentrations theoretically sufficient to exceed their soluble threshold limit concentrations (STLCs); and (*b*) there was no statistically significant difference in the concentrations of either copper or lead as a function of depth. Note that chromium analyses of two samples suggest that chromium (Cr) is present mostly (>90%) in the trivalent form (Table 1). Therefore, Cr (VI) concentrations are below STLC. The exception mentioned above was nickel in one sample; but when WET-tested, the nickel concentration was well below its STLC. In addition, three samples were analyzed for pH and reactive sulfide (Claussen methodology). Average pH of the untreated grit was 8.6, and reactive sulfide was <3 ppm.

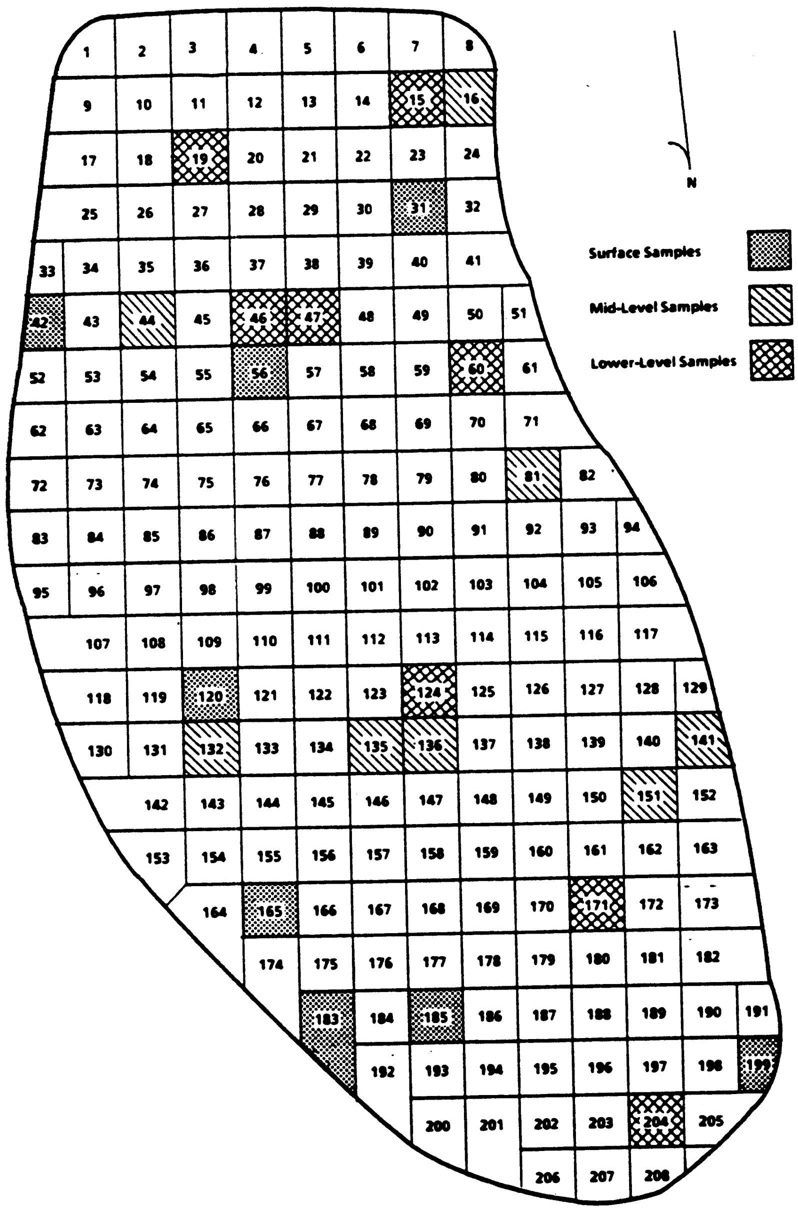


FIG. 1—*Sampling locations on the waste pile.*

TABLE 1—*Analytical data on untreated Hunters Point samples, Nos. 1 to 12.*

TABLE 1—*Analytical data on untreated Hunters Point samples, Nos. 1 to 12.*

| Sample Identification | Metals, mg/kg | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cu | Pb | Sb | As | Ba | Be | Cd | Cr[a] | Co | Hg | Mo | Ni | Se | Ag | Tl | V | Zn |
| HP-1 | 1900 | 250 | <8 | 4.7 | 310 | 0.23 | <0.5 | 110 | 9 | <0.4 | <5 | 45 | <0.5 | <0.5 | <5 | 26 | 1400 |
| HP-1 Dup | 1900 | 280 | <8 | 4.5 | 280 | 0.24 | <0.5 | 110 | 8 | <0.4 | <5 | 45 | <0.5 | <0.5 | <5 | 27 | 1600 |
| HP-2 | 2100 | 230 | <8 | 8.0 | 300 | 0.37 | <0.5 | 180[b] | 13 | <0.4 | <5 | 110 | <0.5 | <0.5 | <5 | 39 | 890 |
| HP-3 | 2100 | 210 | 11 | 8.8 | 320 | 0.29 | <0.5 | 160[b] | 10 | <0.4 | <5 | 66 | <0.5 | <0.5 | <5 | 31 | 2500 |
| HP-4 | 1100 | 160 | <8 | 4.5 | 100 | 0.10 | <0.5 | 44 | 2 | <0.4 | 8 | 25 | <0.5 | 1.3 | <5 | 11 | 68 |
| HP-5 | 990 | 120 | <8 | 4.0 | 250 | 0.23 | <0.5 | 88 | 20 | <0.4 | <5 | 270 | <0.5 | <0.5 | <5 | 26 | 860 |
| HP-6 | 1300 | 110 | <8 | 4.3 | 60 | 0.05 | <0.5 | 26 | 2 | <0.4 | 29 | 10 | <0.5 | <0.5 | <5 | 5.7 | 650 |
| HP-7 | 1900 | 220 | <8 | 4.4 | 270 | 0.19 | <0.5 | 100 | 8 | <0.4 | <5 | 58 | <0.5 | <0.5 | <5 | 22 | 78 |
| HP-8 | 1400 | 170 | <8 | 6.5 | 150 | 0.20 | <0.5 | 72 | 8 | <0.4 | <5 | 90 | <0.5 | <0.5 | <5 | 24 | 78 |
| HP-9 | 2300 | 330 | <8 | 4.2 | 270 | 0.11 | <0.5 | 69 | 4 | <0.4 | <5 | 32 | <0.5 | <0.5 | <5 | 13 | 1500 |
| HP-10 | 2100 | 160 | <8 | 7.8 | 270 | 0.26 | <0.5 | 130 | 11 | <0.4 | 6 | 140 | <0.5 | <0.5 | <5 | 29 | 880 |
| HP-11 | 2300 | 330 | <8 | 5.2 | 340 | 0.16 | <0.5 | 130 | 6 | <0.4 | 9 | 78 | <0.5 | <0.5 | 5 | 19 | 1400 |
| HP-12 | 2500 | 240 | <8 | 3.5 | 280 | 0.12 | <0.5 | 78 | 5 | <0.4 | 6 | 58 | <0.5 | <0.5 | 5 | 15 | 1900 |

[a] Total Cr.
[b] Cr(VI) data: HP-2 = 14 mg/kg; HP-3 = 8.4 mg/kg.

TABLE 2—*Analytical data on untreated Hunters Point samples, Nos. 13 to 27.*

| Sample Identification | Metals, mg/kg | |
|---|---|---|
| | Cu | Pb |
| HP-13 | 1900 | 240 |
| HP-14 | 1900 | 170 |
| HP-14 Dup | 1600 | 180 |
| HP-15 | 1600 | 330 |
| HP-16 | 1700 | 170 |
| HP-17 | 1800 | 200 |
| HP-18 | 1600 | 150 |
| HP-19 | 2000 | 250 |
| HP-20 | 1600 | 86 |
| HP-21 | 2100 | 180 |
| HP-22 | 2000 | 200 |
| HP-23 | 1600 | 180 |
| HP-24 | 1700 | 210 |
| HP-25 | 2600 | 190 |
| HP-26 | 1700 | 170 |
| HP-27 | 1.2 | <5 |

[a] Samples codes are as follows:

1. Samples 1 to 8 and 25 collected from the 0- to 1-m (0- to 3-ft) level [after eliminating the top 8 cm (3 in.)]. Sample 25 is a blind replicate of Sample 1.
2. Samples 9 to 16 and 26 collected from the 1- to 2-m (3- to 6-ft) level. Sample 26 is a blind replicate of Sample 10.
3. Samples 17 to 24 collected from the 2- to 3-m (6- to 9-ft) level.
4. Sample 27 is a blank [reagent silicon dioxide ($SiO_2$) sand].

Average copper, lead, nickel, and zinc concentrations plus standard deviations are shown in Table 3, compared with their total threshold limit concentration (TTLC) values.

The 14 samples with the highest copper and lead concentrations were then extracted according to California WET methodology, and the extracts were analyzed for copper and lead. Twelve samples were also analyzed using the EP Tox test. Average WET and EP Tox copper (Cu) and lead (Pb) concentrations and standard deviations are compared with their threshold values in Table 4. Note that copper is not an EP Tox metal.

The concentrations of both metals exceed their STLCs, and the grit is therefore hazardous

TABLE 3—*Average total metal contents of Hunters Point sandblasting grit samples.*

| | Average, mg/kg | Standard Deviation, mg/kg | TTLC, mg/kg[a] |
|---|---|---|---|
| Copper | 1830 | ± 392 | 2500 |
| Lead | 202 | ± 63 | 1000 |
| Nickel | 82 | ± 70 | 2000 |
| Zinc | 1017 | ± 761 | 5000 |

[a] TTLC = total threshold limit concentration.

TABLE 4—*Average soluble metal contents of Hunters Point sandblasting grit samples.*

| | Average, mg/L | Standard Deviation, mg/L | STLC, mg/L[a] |
|---|---|---|---|
| WET copper | 147 | ± 27 | 25 |
| WET lead | 19 | ± 6 | 5 |
| EP Tox copper | 22 | ± 4 | not applicable |
| EP Tox lead | 0.6 | ± 0.4 | 5 (EPA standard) |

[a] STLC = soluble threshold limit concentration.

in California. However, this grit would not be considered hazardous by the U.S. EPA based on the results of the EP Tox test. Unaveraged data from both the WET and EP Tox tests are provided in Table 5. Analytical methods used to collect the data are listed in Table 6. CAM total and soluble metal limits are compiled in Table 7.

### Phase II: Bench-Scale Treatability Study

This section reports the results of three different chemical fixation procedures tested at bench-scale on selected sandblasting grit samples from HPA. The bench-scale treatability study was conducted by ToxCo, Inc., a California-based stabilization contractor, with both Navy and Battelle witnesses. Battelle provided chain of custody for samples both to and from the premises of the stabilization contractor.

TABLE 5—*Results of leaching tests on selected untreated Hunters Point samples.*

| | WET, mg/L | | EP Tox, mg/L | |
|---|---|---|---|---|
| Sample | Cu | Pb | Cu | Pb |
| Hp-1 | 150 | 18 | 25.2 | 0.53 |
| HP-1 Dup | | | 25.2 | 0.52 |
| HP-2 | 150 | 18 | 29.6 | 0.52 |
| HP-3 | 130 | 35 | 19.9 | 0.22 |
| HP-9 | 160 | 19 | 24.3 | 0.74 |
| HP-10 | 100 | 10 | 15.1 | 0.19 |
| HP-11 | 160 | 17 | 22.8 | 0.51 |
| HP-12 | 200 | 17 | 25.1 | 0.41 |
| HP-14 | 120 | 19 | 12.3 | 0.17 |
| HP-14 Dup | 120 | 21 | 12.4 | 0.21 |
| HP-15 | 130 | 24 | 19.2 | 1.57 |
| HP-19 | 180 | 21 | 22.3 | 0.71 |
| HP-22 | 160 | 15 | 23.7 | 0.54 |
| HP-24 | 150 | 16 | 23.3 | 0.58 |
| HP-25 | 150 | 16 | NA[a] | NA[a] |
| HP-25 Dup | 170 | 21 | | |
| HP-26 | 100 | 11 | NA[a] | NA[a] |
| HP-26 Dup | 120 | 32 | | |

[a] NA = not analyzed.

TABLE 6—*Methods used for chemical analyses.*

TTLC—California Title 22 CCR 66699
STLC—California Title 22 CCR 66699
EP Tox—EPA 1310
MEP—EPA 1320
pH—EPA 9045
Reactive Sulfide—SW-846, Part II, Section 7.3

| METALS, TTLC, STLC, EP TOX, AND MEP | |
|---|---|
| Barium | EPA 7080 |
| Antimony | EPA 7040 |
| Arsenic | EPA 7061 |
| Barium | EPA 7080 |
| Beryllium | EPA 7090 |
| Cadmium | EPA 7130 |
| Chromium, Total | EPA 7190 |
| Chromium (VI) | EPA 7196 |
| Cobalt | EPA 7200 |
| Copper | EPA 7210 |
| Lead | EPA 7420 |
| Mercury | EPA 7471 |
| Molybdenum | EPA 7480 |
| Nickel | EPA 7520 |
| Selenium | EPA 7741 |
| Silver | EPA 7760 |
| Thallium | EPA 7840 |
| Vanadium | EPA 7910 |
| Zinc | EPA 7950 |

TABLE 7—*California Assessment Manual metal limits, California Administrative Code, Title 22, Section 66699.*

| Element | STLC, mg/L[a] | TTLC, mg/kg[b] |
|---|---|---|
| Antimony | 15 | 500 |
| Arsenic | 5.0 | 500 |
| Barium | 100 | 10 000 |
| Beryllium | 0.75 | 75 |
| Cadmium | 1.0 | 100 |
| Chromium, Total | 560 | 2500 |
| Chromium (VI) | 5.0 | 500 |
| Cobalt | 80 | 8000 |
| Copper | 25 | 2500 |
| Fluoride | 180 | 18 000 |
| Lead | 5.0 | 1000 |
| Mercury | 0.2 | 20 |
| Molybdenum | 350 | 3500 |
| Nickel | 20 | 2000 |
| Selenium | 1.0 | 100 |
| Silver | 5.0 | 500 |
| Thallium | 7.0 | 700 |
| Vanadium | 24 | 2400 |
| Zinc | 250 | 5000 |

NOTE: pH should not exceed 12.5 or be lower than 2.0, and reactive sulfide should not exceed 500 mg/kg.
[a] STLC = soluble threshold limit concentration.
[b] TTLC = total threshold limit concentration.

The performance criteria w

1. WET Pb ≲ 5 mg/L.
2. WET Cu < 25 mg/L.
3. pH < 12.5.
4. Reactive sulfide < 500 n

Several different bench-scal results. The problem was tracec were found to be encapsulated compounds and Cu in antifoul Pb and Cu were understood, de sible. Three processes were test ation with a silicate-setting ag of fly ash and cement. Process only.

Soon after treatment, the wa Several days after stabilization a sistency very much resembling t

The treated samples were allc were then analyzed for pH, react lytical laboratory. Averaged resu is shown as a range) on the treate ical data and 95% confidence int

All samples tested using all th below 12.5, and tested below the three processes were considered t 2 and 3 were preferred over Proc entailing the use of an additional

Also, to assess the long-term st (MEP) was conducted on three sa of this test showed no significant r testing period. Additional studies, understand better the long-term s sulfide-based stabilization/solidifi

TABLE 8—*Averaged pe*

| WET Pb, mg/L | WET Cu. |
|---|---|
| <0.4 | <0. |
| <0.4 | <0. |
| <0.4 | <0. |

The performance criteria were as follows:

1. WET Pb < 5 mg/L.
2. WET Cu < 25 mg/L.
3. pH < 12.5.
4. Reactive sulfide < 500 mg/kg.

Several different bench-scale treatability tests were conducted, each with unsatisfactory results. The problem was traced to the physicochemical form of the Pb and Cu in the grit. Both were found to be encapsulated in organic polymeric coatings, Pb most likely in paint pigment compounds and Cu in antifouling compounds. When the complex physicochemical forms of Pb and Cu were understood, devising a successful bench-scale treatability study was then possible. Three processes were tested. All three processes used a sulfide-fixing agent in combination with a silicate-setting agent. In Process No. 1, the setting agent was a combination of fly ash and cement. Process No. 2 used fly ash only, and Process No. 3 used bentonite only.

Soon after treatment, the waste has a rather moist texture and resembles a viscous slurry. Several days after stabilization and curing, the treated sandblasting grit has a texture and consistency very much resembling that of the untreated grit.

The treated samples were allowed to stabilize and cure for two to four days. The samples were then analyzed for pH, reactive sulfide, and WET Pb and Cu by a California-certified analytical laboratory. Averaged results of the chemical analyses (except for reactive sulfide, which is shown as a range) on the treated samples are shown in Table 8 by process. Unaveraged chemical data and 95% confidence intervals are presented in Table 9.

All samples tested using all three processes passed the WET test for Cu and Pb, had a pH below 12.5, and tested below the reactive sulfide guideline of 500 mg/kg. Therefore, any of the three processes were considered to be satisfactory for the field demonstration. Processes Nos. 2 and 3 were preferred over Process No. 1 because of the need to fix fly ash and cement (thus entailing the use of an additional hopper) in the latter. Process No. 2 was used in the field.

Also, to assess the long-term stability of the treated waste, a multiple extraction procedure (MEP) was conducted on three samples of this waste treated by a similar process. The results of this test showed no significant release of either lead or copper (Table 10) during the ten-day testing period. Additional studies, both theoretical and experimental, are being undertaken to understand better the long-term stability of metal sulfides and the potential applicability of sulfide-based stabilization/solidification (S/S) processes in remediation.

TABLE 8—*Averaged performance data from bench-scale treatability studies.*

| WET Pb, mg/L | WET Cu, mg/L[a] | Lab pH | Reactive Sulfide, mg/kg |
|---|---|---|---|
| PROCESS NO. 1 | | | |
| <0.4 | <0.1 | 12.1 | <3 to 20 |
| PROCESS NO. 2 | | | |
| <0.4 | <0.1 | 12.0 | <3 to 65 |
| PROCESS NO. 3 | | | |
| <0.4 | <0.1 | 11.2 | <3 to 300 |

TABLE 9—*Results of leaching tests on bench scale-treated Hunters Point samples.*

| Sample | WET Cu, mg/L | WET Pb, mg/L | pH | Reactive Sulfide, mg/kg |
|---|---|---|---|---|
| | | PROCESS NO. 1 | | |
| HP-7 | <0.1 | <0.4 | 12.6 | 20 |
| HP-13 | <0.1 | <0.4 | 12.0 | <3 |
| HP-17 | <0.1 | <0.4 | 11.7 | <3 |
| HP-19 | <0.1 | <0.4 | 12.0 | <3 |
| | | | 10.4 | 10 |
| | | PROCESS NO. 2[a] | | |
| HP-7 | <0.1 | <0.4 | 12.3 | <3 |
| HP-13 | <0.1 | <0.4 | 12.3 | <3 |
| HP-15 | <0.1 | <0.4 | 11.6 | <3 |
| HP-19 | <0.1 | <0.4 | 11.9 | <3 |
| HP-21 | <0.1 | <0.4 | 11.7 | 65 |
| HP-22 | <0.1 | <0.4 | 12.1 | <3 |
| | | | 0.2 | 21 |
| | | PROCESS NO. 3[a] | | |
| HP-17 | <0.1 | <0.4 | 10.9 | 33 |
| HP-23 | <0.1 | <0.4 | 10.8 | <3 |
| HP-24 | <0.1 | <0.4 | 11.8 | 300 |
| | | | 0.6 | 186 |

[a] 95% Confidence interval.

## Phase III: Field Treatment Demonstration Field Activities

The full-scale demonstration of the treatment technology was conducted in December 1989 after the approval of a detailed work plan by the U.S. Navy and cognizant regulatory agencies. Implementation of the full-scale process was preceded by three pilot-scale tests on approximately 15-$m^3$ (20-$yd^3$) batches of sandblasting grit. The mixing device was a large double-screw pugmill, with a 150 $m^3$ (200 $yd^3$) per hour capacity. We operated the field demonstration at approximately 40 $m^3$ (50 $yd^3$) per hour throughput. The proportions of the ingredients were

TABLE 10—*Analytical results MEP test—Pb and Cu concentrations in sulfide-treated Hunters Point sandblasting grit.*

| | | Posttreatment, Multiple Extraction Procedure | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sample | EP Tox, mg/L | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Day 8 | Day 9 |
| | | | | | PB CONCENTRATIONS | | | | | |
| HP-9 | <0.05 | <0.5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| HP-11 | <0.05 | <0.5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| HP-19 | <0.05 | <0.5 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 |
| HP-19 | | | <0.05 | | | | | <0.05 | | |
| | | | | | CU CONCENTRATIONS | | | | | |
| HP-9 | 0.32 | 0.06 | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| HP-11 | 0.69 | 0.08 | 0.06 | 0.06 | 0.06 | 0.06 | 0.05 | 0.05 | 0.07 | 0.16 |
| HP-19 | 0.17 | 0.07 | 0.05 | 0.04 | 0.05 | 0.03 | 0.03 | 0.04 | 0.04 | 0.07 |
| HP-19 Dup | | | 0.04 | | | 0.03 | | | 0.04 | |

NOTE: The EP Tox test is the first step of the multiple extraction procedure.

varied slightly between
The results from these
by a local analytical lat
performance standarc
demonstration.
After approximately
of sandblasting grit had
nal matters between t
weeks after treatment.
four principal perform
of these analyses.

*500 Cubic Meter Treat*

Several samples of tr
ically analyzed (Table
in depth up to approxi
total) showed that Cu
samples. The late Janu
pile. In these samples.
February samples show
shallow material.
Clearly, some degree

Sample
8 cm (3 in. Depth)
30 cm (12 in. Depth)
8 cm (3 in. Depth)
30 cm (12 in. Depth)
Sample 1
Sample 2
1320-3
1320-4
I-3
II-3
III-3
III-4

[a] pH rounded to neares
[b] Collected from a deptl
[c] Collected from a deptl
[d] Collected from a deptl

varied slightly between these three tests with the intent of identifying the most satisfactory mix. The results from these tests on samples collected immediately in the field and express-analyzed by a local analytical laboratory showed that two of the three mixes passed all of the applicable performance standards. Therefore, the decision was made to proceed with full-scale demonstration.

After approximately one and a half days of field treatment, approximately 500 $m^3$ (600 $yd^3$) of sandblasting grit had been treated. However, field activities were suspended because of internal matters between the Navy and the California Department of Health Services. Several weeks after treatment, samples were collected from the treated waste pile and analyzed for the four principal performance parameters. The following sections briefly summarize the results of these analyses.

### *500 Cubic Meter Treated Pile, December 1989*

Several samples of treated waste from the approximately 500-$m^3$ (600-$yd^3$) pile were chemically analyzed (Table 11). The samples were collected as a function of depth. The pile varied in depth up to approximately 1 m (3 ft). The results of the first three samplings (six samples total) showed that Cu failed the WET test in two of six samples and Pb failed in five of six samples. The late January samples (two samples) were collected slightly deeper in the treated pile. In these samples, Cu passed the STLC in both cases while Pb passed in one case. The February samples showed that the deeper samples were, in general, better stabilized than the shallow material.

Clearly, some degree of Cu and Pb stabilization is evident in the field-treated samples. The

TABLE 11—*Data on the 500-$m^3$ treated pile.*

| Sample | STLC, Cu, mg/L | STLC, Pb, mg/L | pH | Reactive Sulfide, mg/kg |
|---|---|---|---|---|
| | SAMPLES COLLECTED WEEK OF 18 DEC. 1989 | | | |
| 8 cm (3 in. Depth) | 9.3 | 4.4 | 13[a] | <1 |
| 30 cm (12 in. Depth) | 10 | 11 | 13[a] | <1 |
| | SAMPLES COLLECTED WEEK OF 25 DEC. 1989 | | | |
| 8 cm (3 in. Depth) | 50.2 | 10.6 | 12.36 | 25.3 |
| 30 cm (12 in. Depth) | 42.0 | 10.3 | 12.37 | 17.5 |
| | SAMPLES COLLECTED 16 JAN. 1990[b] | | | |
| Sample 1 | 22.5 | 11.8 | 12.1 | <0.005 |
| Sample 2 | 18.5 | 15.3 | 12.0 | <0.005 |
| | SAMPLES COLLECTED 29 JAN. 1990[c] | | | |
| 1320-3 | 13.4 | 3.0 | 12.2 | ... |
| 1320-4 | 15.0 | 7.17 | 12.4 | ... |
| | SAMPLES COLLECTED 20 FEB. 1990[d] | | | |
| I-3 | 6.5 | 8.1 | 12.4 | 27 |
| II-3 | 4.8 | 6.0 | 12.2 | 13 |
| III-3 | 7.7 | 7.8 | 12.4 | 166 |
| III-4 | 8.6 | 6.1 | 12.1 | 19 |

[a] pH rounded to nearest whole unit.
[b] Collected from a depth of approximately 30 cm (12 in.).
[c] Collected from a depth of approximately 30 to 61 cm (12 to 24 in.).
[d] Collected from a depth of approximately 61 to 91 cm (24 to 36 in.).

soluble Cu and Pb levels are lower than what can be accounted for by the small amount of dilution that occurs from the stabilization chemicals and water. However, the degree of stabilization is not sufficient for the grit to be classified as nonhazardous in the state of California, especially in the upper parts of the treated waste pile.

### *Laboratory Treatability Studies*

Several laboratory treatability studies were conducted to help understand the cause of the apparent failure, judging from the field data. The first study compared the effect of the fly ash that was used in the bench-scale test of June 1989 (the basis for the formulation used in the field demonstration) with that of the fly ash that was used in the field demonstration. The stabilization contractor was unable to secure for the field demonstration the exact fly ash that was used in the bench-scale treatability study. We wanted to determine if using the different fly ash could account for the lower degree of stabilization observed in the field.

The result (Table 12) was that there was no difference in the effect of the two fly ashes. Both resulted in satisfactory STLC Cu and Pb levels, pH, and reactive sulfide as observed in the bench-scale test of June 1989. Incidentally, both samples were cured in a jar. The pHs of the two fly ashes were measured and were found to be within several tenths of a pH unit of each other.

Another treatability test evaluated the effect of curing the test samples on a gentle incline in the open air to better simulate field conditions. Some excess stabilization reagent was observed draining off the grit pile, and the treated samples had a lighter color than the samples that cured in the jar. The results yielded WET Cu and Pb levels that were over a factor of ten higher than the jar-cured samples for both metals (Table 12). These results strongly suggested that incomplete curing was the cause of the lower degree of stabilization observed in the field.

A final treatability test consisted of a similar series of tests as described above for the fly ash, except that bentonite was used instead of fly ash. Typical results (Table 12) shows that the bentonite was more effective compared with fly ash in stabilizing the grit when cured in the open air on an incline. However, the degree of stabilization was still not as great as when the samples were cured in a jar. The bentonite appears clearly preferable to the fly ash in these tests, but it is not clear whether the CAM STLC limits would consistently be satisfied in the field application of this technology.

### *Summary*

The hypothesis for the higher-than-expected STLC-soluble Cu and Pb contents in some of the field-treated grit samples is that the reaction between sulfide and metal ions was prevented

TABLE 12—*Data from lab treatability studies conducted since 15 Dec. 1989.*

| | STLC, Cu, mg/L[a] | STLC, Pb, mg/L[a] | pH | Reactive Sulfide, mg/kg |
|---|---|---|---|---|
| COMPARISON OF 2 FLY ASHES CURED IN A CLOSED JAR | | | | |
| Lab Treatability Fly Ash | 0.11 | 0.28 | 11.5 | ... |
| Field Treatability Fly Ash | 0.13 | 0.13 | 12.0 | ... |
| CURED IN THE OPEN AIR ON A SLIGHT INCLINE | | | | |
| Lab Treatability Fly Ash | 33.7 | 3.72 | 11.2 | ... |
| Field Demonstration Fly Ash | 23.5 | 2.83 | 11.9 | ... |
| Bentonite | 3.6 | 2.13 | 11.8 | ... |

[a] STLC = Soluble threshold limit concentration.

from going to completion because various environmental conditions caused the treated grit to cure differently in the field than in a jar. One of the principal factors appears to be the drainage of the dense sulfide reagent away from the upper parts of the treated pile. This effectively stopped the stabilization reaction before completion.

In the laboratory, the samples were cured in the restricted environment of the sample jar, and a higher degree of chemical reaction resulted. An important complicating factor is that Cu and Pb in this grit are encapsulated in organic polymeric antifouling compounds and pigments, which must be penetrated before the reaction between ionic metal species and sulfide can occur. From the bench-scale data, the caustic sulfide setting reagent appears to be capable of slowly degrading these polymers, but the reaction stops when the reagent drains away.

Note also that the soluble silicate binder was incapable of stabilizing the grit in bench-scale studies. This is a commonly used binder, but was not applicable to Hunters Point grit because of the grit's chemical complexity.

## Lessons Learned

This paper addresses two of the more significant of the lessons learned.

1. *Complications due to physicochemical form of the target contaminant.* The unsatisfactory degree of stabilization of the Cu and Pb during the field demonstration was a direct result of their encapsulation in organic coatings of various types (antifouling compounds, pigments, etc.). Persons conducting stabilization/solidification treatability tests frequently measure the type and amount of contaminant present. But, in complex waste forms such as the Hunters Point sandblasting grit, type and amount of contaminant are not sufficient information. Also important is understanding the physicochemical form of the contaminant.
2. *Jar effect during curing.* The jar environment promotes good contact between the binder and waste form and clearly led to an enhanced degree of stabilization over that which occurred in the field. During laboratory treatability studies, curing the waste in a setting that simulates as closely as possible the conditions that will be encountered in the field is important.

## Postscript

The data contained in this report might lead to the erroneous conclusion that the sulfide-based stabilization technologies described herein are ineffective. To the contrary, there are numerous instances where such technologies have been used successfully in the field, resulting in products having stability in an appropriate disposal environment. Once the metal sulfide salts are formed, they appear to be very stable for long periods of time unless exposed to acid and oxidizing conditions simultaneously. Free sulfide (unreacted with metals) left over after completion of the S/S reactions appears to oxidize fairly readily upon aeration. We are studying the long-term stability of metal sulfides and the S/S conditions necessary to form metal sulfides that have long-term stability in the environment.

The sulfide-based formulations described in this report were selected after a number of other conventional binders were clearly shown to be unsatisfactory for this waste form, which, as indicated above, was difficult to stabilize because of the organic polymer coatings on the metals. The sulfide binders have a role in stabilization technology where other conventional technologies are unable to meet the necessary performance criteria.

Finally, recent developments in the California Department of Health Services policy appear to make it possible to recycle the Hunters Point sandblasting grit into asphalt or other composites. This policy, which is expected to be made official in 1991, would only apply to California (not RCRA) wastes (*a*) that do not exceed the TTLCs; (*b*) whose WET-soluble metal contents will be brought below the STLCs by dilution in the asphalting process; and (*c*) that have a beneficial contribution to the physical integrity of the composite. Pending approval of this new DOHS policy, the 2300 m³ (3000 yd³) of sandblasting grit at Hunters Point will be legally recycled into asphalt.

*J. C. Nominé[1] and*

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December 21, 1992

Battelle Memorial Institute
Environmental Technology
505 King Avenue
Columbus, Ohio 43201-2693

Attn: Mr. Karl Nehring

Dear Mr. Nehring:

Enclosed is your copy of the technical paper presented at the HAZMAT West Conference on November 12, 1992. Dr. Leonard and I greatly appreciate your contribution to the preparation of this paper, and hope that both ABM reuse technologies are positively promoted by the effort.

Please feel free to contact me at (916) 362-5332 if you have any questions or require additional information.

Sincerely,

Allan J. Priest

Allan J. Priest
Scientist

cc: R. Leon Leonard

**California Hazardous Waste Minimization Through Alternative Utilization of Abrasive Blast Material**

Prepared By

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Radian Corporation
Sacramento, CA

Dr. Jeffrey L. Means and Karl W. Nehring
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Naval Civil Engineering Laboratory
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HAZMAT West Annual Conference
November 12, 1992

## 1.0 INTRODUCTION

Abrasive Blast Material (ABM) is an industrial hazardous waste that is generated in substantial quantities throughout California and the nation. Historically, this waste has been subject to handling and management for hazardous waste landfill disposal. However, as the costs of landfill disposal continue to increase and waste generators are increasingly subject to long term potential liability for landfill disposed wastes, alternative means of disposal of ABM and other high volume waste streams are being examined. A number of alternative technologies for utilization of ABM are currently under scrutiny by hazardous waste industry professionals and the California EPA Department of Toxic Substances Control (DTSC).

This paper compares two alternative reuses of waste ABM. The first process incorporates ABM as a feedstock in the manufacture Portland cement. This demonstration project is a cooperative effort by Radian Corporation, Southwestern Portland Cement Company, and Mare Island Naval Shipyard. The second alternative incorporates waste ABM in asphalt concrete for roadbed material. This technology was demonstrated by Battelle Memorial Institute, on behalf of the U.S. Naval Civil Engineering Laboratory, and Naval Station Treasure Island.

Section 2.0 of this paper includes a description of the process which generates ABM, the characteristics which make it a hazardous waste stream, and incentives for long term waste reductions for generators in California. Section 3 describes the alternative use of waste ABM in the production of Portland cement, and Section 4 presents a similar evaluation of the application of ABM into asphalt roadbed material. These discussions present an evaluation of the technical, regulatory, and economic feasibility of the two ABM reutilization alternatives. The final sections of this paper summarize the potential and long term viability of the two alternative processes for ABM recycling.

## 2.0 GENERATION OF ABRASIVE BLAST MATERIAL (ABM)

ABM is generated while preparing metallic surfaces for the application of protective coatings. During the process; equipment, vehicles, ships, aircraft, materials, and any number or types of parts are subjected to a high pressure stream of mineral abrasive to remove old coatings, corrosion, rust, or other surface contaminants. This effective and relatively inexpensive procedure results in a clean, contaminant-free surface necessary for good quality application of corrosion protective coatings.

During the blasting operation, the residual material is either disposed or, more commonly, collected, filtered, and reused. In order to provide the most effective cutting or material removal rate, the physical characteristics of the ABM used in the blasting process must be maintained. The ABM must be of adequate size, display low dust generation, and provide surface profile requirements that meet specific performance standards associated with the blasting process. In larger blasting processes, an automatic collection, filtration, and reuse system is commonly employed, with only residual contaminants and ABM fines disposed as waste. The waste is generally accumulated in hoppers, drums, or large covered piles or containers prior to analysis, transportation and disposal as hazardous waste. In some processes, the physical characteristics are not maintained after use and disposal of ABM is required following a single use.

The ABM waste streams included in these two demonstration projects were generated during shipyard operations at two U.S. Naval facilities in the San Francisco Bay Area. Together, the Mare Island Naval Shipyard (Vallejo) and Hunter's Point Naval Shipyard-Annex (San Francisco) combined to generate approximately 2,285 tons of ABM waste during surface cleaning operations in 1990.

## Waste Characterization

During the blasting process, ABM becomes contaminated with minute particles of inorganic constituents from the metal alloy surface, coatings, or other material previously adhered to the part. It is these metal contaminants that result in the designation of ABM as a hazardous waste. The ABM waste streams for the two alternative technologies discussed in this paper are California hazardous wastes because soluble concentrations of copper and lead exceed the soluble threshold limit concentration (STLC) for these metals. Therefore, ABM waste must be accumulated, stored, transported, and disposed according to applicable state hazardous waste regulations.

## Incentives for Developing ABM Waste Management Alternatives

There are a number of incentives for government and private industries and waste generators to develop and implement alternatives to landfill disposal of hazardous wastes, especially large volume waste streams like ABM. These include economic incentives, regulatory requirements, long term liability, internal management directives, and public health and safety.

### Economic Incentives

As a result of increasing demand and decreasing supply of hazardous waste landfills, the costs of waste transportation and disposal are increasing substantially. The State of California now has one (1) hazardous waste landfill currently in operation, Chemical Waste Management's™ Kettleman Hills facility. California's non-treatable wastes that are subject to landfill disposal are either transported to Kettleman Hills or to other states, at a substantial economic cost to the generator. Currently, estimated landfill disposal costs for ABM range from $200/ton to $500/ton, based on the type and extent of contamination in the waste. As described below, recycling ABM using either of these processes could reduce this cost by more than 50%.

### Regulatory Waste Minimization Requirements

The regulatory incentive for waste reduction at the state level includes the State of California Hazardous Waste Source Reduction and Management Review Act of 1989 (commonly known as Senate Bill [SB] 14). This act requires hazardous waste generators to prepare a number of reports that summarize waste generation and management activities during a baseline year, and propose source reduction and recycling efforts to be initiated by the generator. Every four years thereafter, the generator is required to re-complete the reporting and evaluation exercise, assessing the progress in waste minimization alternatives and proposing new efforts for the upcoming period. As of September 1, 1991, the state requires that SB14 documents be maintained at each applicable facility and that they be available for review and evaluation upon demand by the DTSC.

The federal Hazardous and Solid Waste Amendments of 1984 (HSWA) require hazardous waste generators to certify on manifests that they have a waste minimization program in place. Operators of treatment, storage, and disposal facilities (TSDF) under RCRA are also required to make the same certification annually.

The Pollution Prevention Act applies to industries that are required to file an annual toxic chemical release inventory (Form R) under Section 313 of the Emergency Planning and Community Right to Know Act (EPCRA). The intent of the Pollution Prevention Act is similar to California's SB14 source reduction emphasis. This federal act requires annual reporting on the status of pollution prevention efforts on the U.S. EPA Form R. This information is publicly available through the Toxics Release Inventory (TRI) database.

### Long Term Liability

Although there is limited basis for evaluation of this issue, many hazardous waste generators foresee potential liability to them for long term, post-closure management of hazardous waste landfills. It is clear that management of landfills will be required for decades or even centuries following closure and it is projected that, at some point in the future, generators may be required to provide funding and support of management and clean-up activities. The extent of this support will most likely be based on the relative amount and types of wastes that each hazardous waste generator contributed to a given landfill. Therefore, landfill diversion alternatives are becoming increasingly attractive to hazardous waste generators who wish to reduce their potential liability for long term support and management.

### Internal Directives/Business Missions

In recognition of existing and upcoming regulatory requirements, long term liability, economic incentives, worker and public health and safety issues, and a general increase in environmental awareness, many companies and agencies are modifying their mission statements to include pollution prevention. Although not in all cases, these mission statements often result in internal company directives to minimize unnecessary wastes and develop alternative processes that reduce wastes at the source.

For several of the above reasons, the U.S. Navy has adopted short and long term goals and a proactive approach to reducing hazardous waste generation and disposal. Research and development programs coordinated by the Navy have provided state of the art technologies in pollution prevention and hazardous waste management. The two demonstration programs presented in this paper illustrate the continuing expansion of industry's mission to reduce the amount of waste generated for landfill disposal each year in the United States.

## 3.0 ABM UTILIZATION IN THE MANUFACTURE OF PORTLAND CEMENT

### Process Overview

The manufacture of Portland cement includes preparation, grinding, and exact proportional mixing of mineral feedstocks followed by heating and chemical processing in the kiln. The raw materials necessary for cement production include limestone (or another source of calcium carbonate), silica, alumina, and iron oxides which can be provided by clay, diatomaceous earth, industrial process wastes or other sources. The feedstocks are tested for chemical and physical constituents and are mixed in exact proportions to obtain required properties of the produced cement.

In the more energy-saving kiln operations, the raw materials are fed through a "calciner". This process uses residual heat from the kiln and adds additional heat to begin the important calcining reaction or the disassociation of carbon dioxide from the calcium carbonate to form calcium oxide or "quicklime".[1] Figure 1 presents a simplified diagram of the cement manufacturing process for a kiln equipped with a precalciner. In older cement manufacturing operations, the process is somewhat simplified and limited to a single rotating kiln in which all calcining and chemical reactions occur.

Regardless of the process, the material is passed through the rotary kiln which heats the mixture up to 2750 degrees F. At this temperature, the calcium oxide reacts with silica and alumina to form calcium silicates and aluminates, the primary components of cement. The resulting products at the end of the kiln are hardened nodules called "clinker". These nodules are allowed to cool and are then finely ground and combined with gypsum to create the final product, Portland cement.

### Summary of Radian/Southwestern Portland Cement/Navy Demonstration

The objective of this project is to demonstrate that ABM can be successfully added as a raw material in cement kilns and recycled without adverse impact to the public health or operating conditions of the kilns. As a metal-bearing, sand-based material, ABM

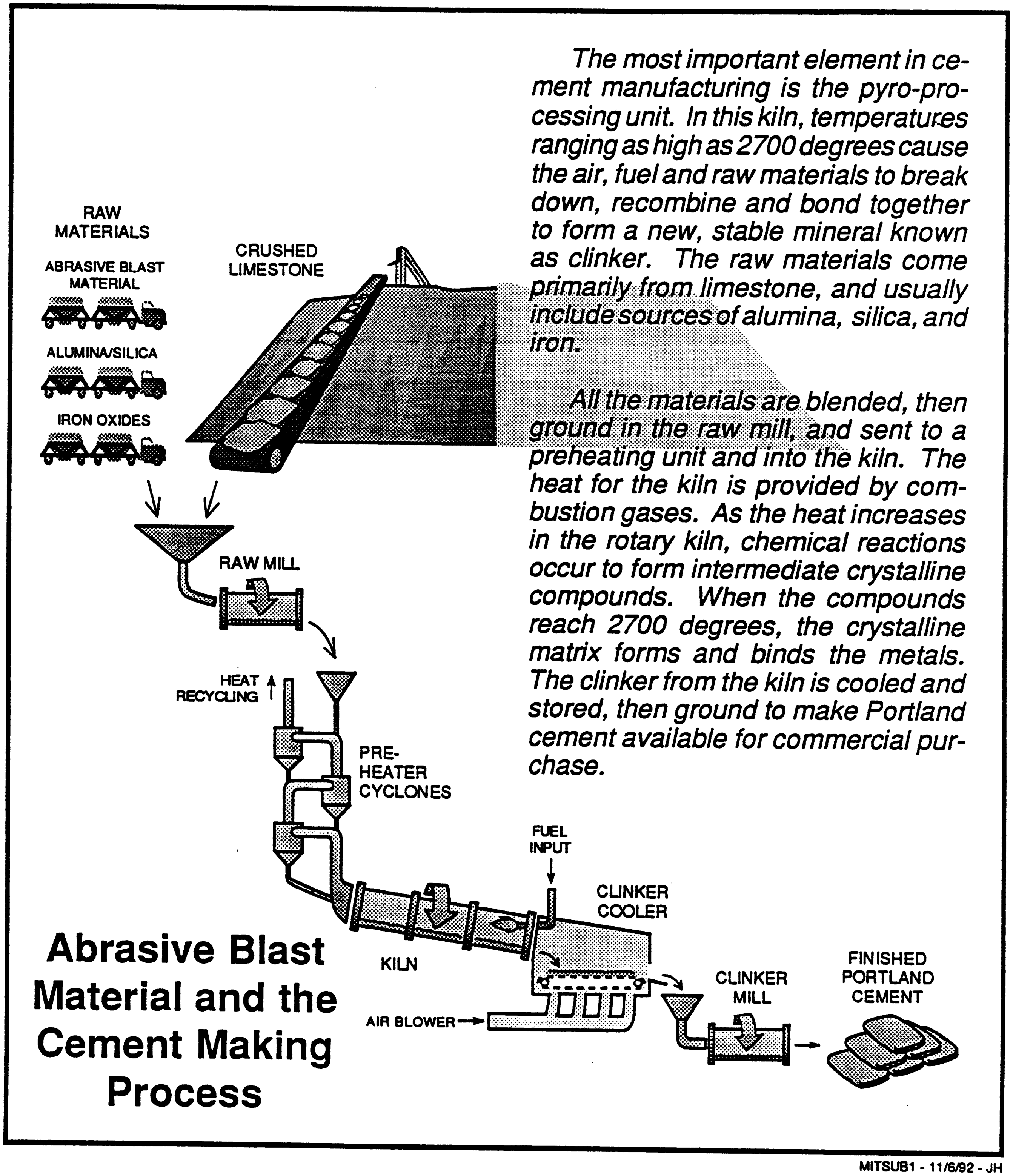


Figure 1. Abrasive Blast Material and the Cement Making Process

from the Mare Island Naval Shipyard operations provides a source of silica, iron oxides, and alumina, three crucial elements in cement manufacturing.

ABM from Mare Island Naval Complex, located approximately 35 miles northeast of San Francisco, was transported by rail to SWPCC's cement manufacturing facility in Victorville, California. Actual TTLC analytical test results for Mare Island's waste ABM are presented in Table 1. This report indicates that a particular sample exceeded the TTLC limit for copper. Table 2 presents a composite summary of TTLC and STLC analytical analyses conducted on Mare Island's waste stream. As shown, the total and soluble concentrations of copper, lead, mercury, and nickel may exceed relative limits in this waste.

During the demonstration tests, ABM was introduced as approximately 1 % of the total feedstock of the kiln and emissions monitoring was conducted to identify any fluctuations in the air emissions concentrations from the process. The final product was then subjected to physical and chemical analysis to determine the structural integrity of the product and whether the metals are bound in the crystalline structure of the cement. The results of these tests are not yet available.

### Feasibility of Proposed process for HW Reduction

Based on the available evidence from the test operation of the kiln with approximately one percent of the feedstock represented by ABM, the process is considered a technical success. The variable proportions of raw material feeds and subsequent additions of Mare Island ABM appear to have no detrimental impacts on the physical or chemical properties of the final product. Addition analysis and evaluation is currently underway to verify initial findings and to determine the effects of minor modifications to the process.

### Viability of Recycling Other Types of Spent Abrasive into Portland Cement

In concurrence with the recycling of ABM, Radian and SWPCC are also demonstrating the potential reuse of other metal bearing wastes in the cement manufacturing process. These similar hazardous waste streams include sewage sludge incineration ash, waste foundry sand, and foundry baghouse waste.[2] It is projected that these wastes will be suitable for incorporation into the cement manufacturing process, without adverse impacts to the environment or potential long term liability for the waste generator. The results of these demonstrations are currently under evaluation by industry analysts and the DTSC.

Essentially, any metal-bearing hazardous waste that adequately displays criteria for cement kiln feedstocks, can be examined for long term recycling in cement kiln operations. It is anticipated that greater numbers of such waste streams may be identified as the technology is refined and successfully applied to ABM, incineration ash, and foundry wastes.

## Table 1

## TTLC Analytical Results for Mare Island Waste ABM

| Contaminant | Detection Limit (mg/kg) | Sample Result (mg/kg) | TTLC Limit (mg/kg) |
|---|---|---|---|
| Antimony | 0.08 | 2.14 | 500 |
| Arsenic | 2.0 | 25 | 500 |
| Barium | 0.09 | 1080 | 10000 |
| Beryllium | 0.06 | 1.1 | 75 |
| Cadmium | 0.02 | 2.36 | 100 |
| Chromium (III/IV) | 2.0 | 90 | 2500/500 |
| Cobalt | 0.4 | 70.3 | 8000 |
| Copper | 0.1 | 3120**** | 2500 |
| Lead | 0.02 | 33.3 | 1000 |
| Molybdenum | 0.02 | 9.11 | 3500 |
| Nickel | 3.0 | 62 | 2000 |
| Selenium | 0.3 | ND | 100 |
| Silver | 0.02 | 0.92 | 500 |
| Thallium | 0.02 | 0.18 | 700 |
| Vanadium | 7.0 | 118 | 2400 |
| Zinc | 0.06 | 197 | 5000 |

**** = Exceeds TTLC limits

ND = Not Detected

Chromium reported as total chromium in results.

## Table 2

## Composite Summary of TTLC and STLC Test Exceedances for Mare Island Waste ABM

| Metal | Total Concentration Range (mg/kg) | TTLC Limit (mg/kg) | Soluble Concent. Range (mg/kg) | STLC Limit (mg/kg) |
|---|---|---|---|---|
| Copper | 1,700 - 4,800 | 2,500 | 2.8 - 220 | 25 |
| Lead | 35 - 101 | 1,000 | 1.6 - 3.1 | 5 |
| Mercury | 0.004 - 5.6 | 2,000 | 0.0005 - 0.01 | 0.2 |
| Nickel | 61 - 980 | 2,000 | 5.2 - 23 | 20 |

Note: Variability of waste is dependent upon the materials and types of paint subjected to removal.

### Anticipated reductions in Waste Disposal

The are 11 cement manufacturers currently operating 20 Portland cement kilns in the state of California. In 1989 alone, these operations reported the cumulative production of more than 10.4 million tons of cement clinker[1]. Due to gaseous losses during the calcining reaction, approximately 13.5 million tons of feedstock was required to generate the cement. Therefore, if only one tenth of one-percent of the required feedstock for each of these kilns were dedicated to recycling of metal bearing wastes, up to 13,500 tons of hazardous waste could be diverted from landfill disposal each year.

However, additional demonstrations of this proposed technology as well as extensive evaluation by the DTSC will be required before long term, practical application of the process can occur.

### Economic Evaluation

The utilization of ABM in the cement manufacturing process presents a positive economic opportunity to both the waste generator and the operator of the cement kiln. The demonstration project is not fully complete, therefore, accurate cost estimates for implementation of this alternative are not available. However, it can be estimated that incorporating ABM into cement kiln feedstocks may reduce the generator's cost of waste disposal by up to 50%.

### Summary

Initial results of this ongoing demonstration project has shown that the substitution of waste ABM as a feedstock in cement manufacture can provide an excellent long term opportunity for recycling of this material. Additionally, it will reduce the both volume of waste which would otherwise need disposal and the subsequently eliminate the long term liability for the generator.

## 4.0 ABM UTILIZATION IN ASPHALT ROADBED MATERIAL

This section summarizes a field demonstration by Battelle for the Naval Civil Engineering Laboratory to determine whether spent ABM from ship-cleaning operations can be used as a raw material in the manufacture of asphalt concrete for commercial paving applications. The process of using the ABM in asphalt is summarized, followed by discussions about the technical, regulatory, and economic viability of the proposed process.

### Process Overview

This demonstration project involved the transportation of a small quantity (approximately 8 tons) of sandblasting waste from Naval Station Treasure Island, Hunters Point Annex (HPA) to an asphalt hot plant. The ABM was generated during ship cleaning and equipment overhaul activities during past Navy operations at the facility. HPA is located several miles south of San Francisco on San Francisco Bay. The ABM currently stored at HPA has the physical characteristics of a coarse-grained beach sand and, during this demonstration, was used as a "blender sand" for a portion of the sand-sized aggregate that normally goes into the production of asphalt concrete.

Total metal concentrations in the HPA abrasive blast wastes do not exceed TTLC. A summary of the WET-soluble metals concentration data is provided in Table 3. As shown, copper and lead exceed their respective STLCs; therefore, the grit is considered hazardous in California. Although copper, lead, and zinc are the primary metal contaminants, traces of several other metals are also present.

Table 4 summarizes the TCLP and EP Toxicity Characteristic leaching data for the HPA waste sandblasting material. None of the metals exceeds its TCLP threshold; therefore, the waste is not a hazardous waste.

Reed and Graham, Inc. of San Jose, California, was the asphalt contractor for this demonstration. At their hot plant, the grit was screened to remove debris, weighed, and then mixed with graded aggregate and bitumen at elevated temperatures in the asphalt hot plant to produce paving-grade asphalt concrete. The loose asphalt concrete was then transported to HPA and rolled into test strips for short- and long-term testing to determine regulatory compliance and the long-term durability of the product. Numerous analytical data were collected both prior to, during, and after the field demonstration to characterize the chemical and physical integrity of the asphalt concrete product as well as to determine the extent of air emissions during screening and asphalt production.

## Summary of Battelle/U.S. Navy Demonstration

The field demonstration was conducted on November 23, 1991. A series of asphalt concrete test strips were placed on top of existing pavement at HPA. The objective was to determine whether the resulting asphalt concrete product complies with California EPA policy on "Use Constituting Disposal" for waste material recycling into construction materials. This policy specifies a number of criteria that must be satisfied, such as (a) maximum total and soluble contaminant levels that may be contained in the asphalt concrete product; (b) physical specifications for demonstrating that the asphalt concrete product will perform well under vehicular traffic; (c) a demonstration that the recycling activity does not create a significant risk, either in terms of occupational exposure during the manufacture of the asphalt concrete at the hot plant or in terms of long-term exposure of the general public or the environment to the asphalt concrete after it has been applied to the pavement.

The loading and transportation of ABM waste from HPA to Reed and Graham Inc. in San Jose took place on Wednesday, November 20, 1991. An equipment contractor provided a water truck and operator to wet down the work area and minimize dust emissions during sandblast material excavation and the movement of heavy equipment at Hunter's Point.

# Table 3

## Mean Wet-Soluble Metal Contents (STLC Analysis) for Hunter's Point ABM Grit Samples

| | Soluble Metal Concentration (mg/L) | |
|---|---|---|
| Element | Hunter's Point ABM | STLC* |
| Cu | **144 | 25 |
| Pb | **19 | 5 |
| Sb | NA | 15 |
| As | 0.06 | 5 |
| Ba | 6.8 | 100 |
| Be | <0.03 | 0.75 |
| Cd | <0.06 | 1 |
| Cr (Total) | 2.0 | 560 |
| Cr (VI) | <1.0 | 5 |
| Co | <0.2 | 80 |
| Hg | <0.01 | 0.2 |
| Mo | <1.0 | 350 |
| Ni | 1.0 | 20 |
| Se | <0.01 | 1 |
| Ag | <0.05 | 5 |
| Te | <0.3 | 7 |
| U | <1.0 | 24 |
| Zn | 146 | 250 |

* From California Code of Regulations, Title 22, Section 66699
STLC = soluble threshold limit concentration

** Exceeds STLC criterion

NA = Not Analyzed

## Table 4

### Mean TCLP and EP TOX Soluble Metal Contents for Hunter's Point ABM Grit Samples

| | Soluble Metal Concentration (mg/L) | |
|---|---|---|
| **Element** | **Sample Result** | **TCLP Limit*** |
| Pb | *1.11 | 5 |
| As | <0.5 | 5 |
| Ba | <5 | 100 |
| Cd | <0.05 | 1 |
| Cr | <0.5 | 5 |
| Hg | <0.02 | 0.2 |
| Se | <0.05 | 1 |
| Ag | <0.05 | 5 |

* EP TOX value is 0.6 mg/L vs. an EP TOX limit of 5 mg/L.

During the pilot-scale field demonstration from November 19th through November 23, 1991, a series of air monitoring tests were conducted. The tests were designed to assess the potential health impacts of dust generated by various activities associated with the asphalt recycling process. Tests were included to measure the background levels of windborne dust plus ambient concentrations of Cu, Pb, and Chromium (Cr). These levels were compared to the concentrations from the process being monitored. Personal samplers were also included to assess any potential for equipment operators to be exposed. A portable meteorological monitoring instrument was used to collect site-specific wind speed and direction during the tests.

The total dust concentrations were very low at both upwind and downwind locations. It should be noted that the wind speed was also low during the entire time period. Only the personal samplers showed any significant dust concentrations, and these were orders of magnitude below the OSHA-regulated values for worker exposures to inert dusts.

The asphalt concrete containing ABM was produced at the Reed and Graham hot plant starting around 8:00 a.m. on November 23, ending approximately 12:30 p.m. Ms. Jessie Schnell of California EPA, DTSC, observed the activities at the asphalt plant. Two different batches of asphalt concrete test material were produced:

- A control batch, containing only normal, graded aggregate and no ABM; and

- Asphalt concrete containing sandblasting wastes from HPA.

The actual batching process required only 10-15 minutes per batch, resulting in approximately 30 tons of test asphalt concrete per batch. Approximately 1.5 tons of sandblasting grit was incorporated into each of the two 30-ton batches of test asphalt, therefore corresponding to an average grit concentration of approximately 5% by weight. After each batch was produced, the asphalt concrete was transported immediately to HPA for paving. Elapsed time between production and paving was critical, because the asphalt concrete needs to be approximately 250°F or hotter for effective paving.

A 30-ton batch of asphalt concrete provides sufficient material to pave approximately 2,400 square feet of roadway at an average thickness of 2 inches. The asphalt concrete test material was successfully transported to HPA without incident and applied to six different test strips at HPA, as follows:

- Two strips containing standard production (control) asphalt concrete; and

- Four strips containing HPA sandblasting grit.

Chemical and physical tests were performed on the asphalt concrete test specimens to determine compliance with California EPA "Use Constituting Disposal" policy criteria. In the chemical tests, the asphalt with and without the HPA grit was analyzed for total and WET-soluble Cu and Pb content to determine compliance with DTSC recycling criteria and also to calculate the average grit composition of the asphalt production runs containing HPA grit. The analytical data are presented in Table 5. All of the total and WET-soluble Cu and Pb contents are well below their respective Title 22 TTLC and STLC values, therefore evidencing compliance with the proposed California EPA, DTSC policy regarding Use Constituting Disposal.

Physical properties measurements were obtained to determine compliance of the grit-containing asphalt concrete with Caltrans standards. The physical properties test used was the ASTM D1560-81 (Hveem Method). Data collected according to the Hveem Method include (1) bitumen or asphalt content, (2) stabilimeter value, (3) cohesiometer value, (4) test temperature, (5) density of asphalt-treated grit mixture, and (6) air voids ratio.

The Hveem Method is currently adopted by Caltrans and involves two principal tests. The first test, the stabilimeter test, is a type of triaxial test that determines the resistance to deformation of compacted asphalt mixtures by measuring the lateral pressure developed when applying a vertical load using the Hveem stabilimeter. The second test, the cohesiometer test, determines the cohesion of the compacted asphalt mixtures by measuring the force required to break or bend the sample as a cantilever beam using the Hveemcohesiometer. Other information obtained from the cohesiometer test are the density and air voids properties of the grit-containing asphalt samples.

Results for the physical properties tests for standard asphalt-concrete (control), and asphalt concrete containing Hunter's Point ABM are presented in Table 6. The results show that the tested samples adhere to Caltrans standards, thus indicating the suitability of the grit-containing asphalt concrete for commercial paving operations.

## Feasibility of Proposed Process for HW Reduction

Based on the first round of analytical measurements, the asphalt test strips laid at HPA appear to have excellent physical integrity and easily meet the California EPA TTLC and STLC criteria for total and soluble metals content. Additional physical and chemical data will be collected to assess the long-term stability of the test strips and the effects of vehicular traffic on the long-term stability as well as the extent of metals leaching from the test strips.

## Viability of Recycling Other Types of ABM into Asphalt Concrete

This process has potential applicability for any solid waste that has the physical characteristics of some portion of the graded aggregate used in the production of asphalt concrete and that contains relatively low levels of metal contaminants. Spent sandblasting grit is a most attractive medium for recycling because: (a) its sand-size particles are of the size that asphalt concrete typically contains a significant amount of; (b) it is easy

## Table 5

## Metals Data on Asphalt Concrete Test Specimens

| | Total (mg/kg) | | WET-Soluble (mg/L) | |
|---|---|---|---|---|
| **Sample ID** | **Cu** | **Pb** | **Cu** | **Pb** |
| Control Asphalt Core | 21 | 3.0 | 0.088 | 0.050 |
| Control Lab Pellet | 16 | 3.0 | 0.034 | 0.050 |
| Test Sample Asphalt Core | 93 | 17 | 1.2 | 0.056 |
| Test Sample Lab Pellet | 74 | 11 | 0.098 | 0.050 |
| Loose Test Sample | 110 | 20 | 1.8 | 0.050 |

## Table 6

## Physical Asphaltic Concrete Tests

| Test Performed | Lab Control | Lab Test Sample | Test Limit Criteria |
|---|---|---|---|
| Percent oil by weight of aggregate | 5.4% | 5.3% | |
| Percent oil by weight of mix | 5.2% | 5.0% | |
| Maximum Theoretical Unit Weight (ASTM D-2041) | 153.8 PCF | 154.6 PCF | |
| Laboratory Compacted Unit Weight | 150.8 PCF | 150.7 PCF | |
| Percent Voids | 1.9% | 2.6% | 4(min)(-)8(max)+ |
| VEEM Stabilimeter Value | 36 | 39 | 35(min)++ |
| Compacted appearance of VEEM specimens | flushing | flushing | |
| Swell (CA 305) | 0.000 In | 0.000 In | 0.030 In(max) |
| Cohesiometer (CA 306) | 430 | 406 | 50(min)+++ |

\+ Asphalt Institute (1962) criteria: minimum value for Hveem test, maximum value as listed for Marshall Test. Note that there is no maximum % voids, value for the Hveem Test in the Asphalt Institute (1962) criteria.

++ Caltrans criteria for medium-traffic applications.

+++ Asphalt Institute (1962) criteria.

PCF = pounds per cubic foot.

to handle, i.e., load, unload, and sieve if necessary; and (c) metal contaminant concentrations are typically low, usually consisting of relatively low levels of Pb and/or other trace metals.

The HPA abrasive blasting waste is ideal for this application because it is predominantly a quartz beach sand with relatively low levels of Pb and Cu contaminants. Many thousands of tons of metal-contaminated ABM are generated annually, not only through ship-cleaning operations, but also by the sandblasting of bridges, usually managed by the State Department of Transportation. A wide variety of types of abrasive are used by sandblasting vendors, including various metal slags, slag from coke production, and steel grit. Some of these materials have properties that are not conducive to asphalt concrete recycling. For example, steel grit is very dense and expands when it oxidizes. Certain ABM produced from slag has too fine a particle size or contains metal in their reduced states that can oxidize in the roadbed. Other properties that need to be evaluated on a case-by-case basis include the oil adsorption and mixing characteristics of the ABM, its density, and the total and soluble metals content of the ABM, which, in turn, directly relates to the overall risk posed to health and the environment associated with the recycling activity.

While certainly not all ABM is suitable for incorporation into asphalt concrete, if even 10-20% of the volume of annual ABM waste stream is the United States were recycled, the savings, both in terms of disposal cost and landfill space, would be substantial.

## Economic Evaluation

The cost to dispose of the sandblasting grit in a regulated landfill is approximately \$500/ton, ±\$200/ton, depending on the particular waste type and landfill. In contrast, the cost to incorporate the ABM into asphalt concrete has been estimated at approximately \$30/ton (approximately \$20/ton in tipping fees to the asphalt contractor plus \$10/ton in transportation costs).

These figures indicate a clear economic advantage for the asphalt concrete option. In addition, there is a compelling economic incentive for the asphalt companies to use the grit for producing asphalt concrete. Rather than pay approximately \$10/ton for raw materials to use in their asphalt, these companies can instead be paid \$20/ton to use the sandblasting grit.

## Asphalt Summary

The HPA asphalt/sandblasting grit field demonstration of November 19-23, 1991, was carried out without incident or unexpected occurrence, in compliance with the Work Plan developed for this project. The goals of the field demonstration — namely, to lay asphalt concrete test strips at Hunter's Point for further test and evaluation and to collect air emissions data during grit handling, were all accomplished. The sandblasting grit content of the test strips averages approximately 4.5 to 5.0 ±1.5 weight percent, which is in a suitable range for testing purposes. Additionally, based on the first round of analytical measurements, the asphalt test strips installed at Hunter's Point appear to have excellent physical integrity and easily meet the California EPA's TTLC and STLC criteria for total and soluble metals content, respectively. Additional physical and chemical data will be collected to assess the long-term stability of the test strips and the effects of vehicular traffic on the long-term stability as well as the extent of metals leaching from the test strips.

The air monitoring data suggest very low levels of dust and metal-laden particulates throughout all operations. A small amount of particulate copper was measured at a downwind filter sampler during the grit screening operation. However, the copper level was well within OSHA guidelines. Also, the screening operation was conducted without dust suppression, and grit emissions could be reduced considerably, upon implementation of simple dust suppression techniques such as wetting.

In the next phase of the project, the test strips at Hunters Point Annex will be sampled approximately every six months to determine whether there has been any change in the metals content of the asphalt concrete or any other evidence of metals leaching. Also, three of the six test strips will be subjected to a road-grinding operation that will include extensive air monitoring to determine any potential hazard to the occupational workforce or to the public caused by inhalation of metal-contaminated dust generated during this operation.

## 5.0 COMPARISON SUMMARY OF ABM UTILIZATION TECHNOLOGIES

An objective comparison of these two demonstrated uses of ABM; 1) incorporation into cement feedstock; and 2) incapsulation in asphalt roadbed, indicates that both are safe, technically feasible, and economically attractive alternatives to landfill disposal. The following discussions briefly compare the two recycling alternative. Additional review, following final emissions estimations, specific cost analyses, and regulatory rulings, would be necessary to complete a comparison of the two use alternatives.

### Expected Change in Waste Volumes

Given the substantial volumes (in millions of tons) of cement and asphalt concrete manufacturers and available facilities throughout California, there are few foreseeable limits to the diversion of ABM wastes from landfill disposal. Without additional marketing data to support one alternative over another, the recycling alternatives should be considered equally apt to reduce disposal of waste ABM.

### Technical Feasibility

As a measure of the overall feasibility and potential of an alternative to be applied to the given waste stream as well as other applications, both demonstrations have been proven technically successful to date. The cement kiln utilization alternative could be considered slightly more so, due to the greater variety in the types of feasible blasting material that can potentially be applied to the process (i.e. slag, steel peen).

## Economic Feasibility

The economic incentives for both the generator and receiver of waste ABM are very important considerations in this or any comparison evaluation. Based on initial estimations, either alternative has been estimated to reduce ABM disposal costs by as much as 50% or more. However, until each process becomes commercially available, accurate estimates of true savings are not feasible.

## Effects on Product Quality

Based on the initial results of both demonstrations, neither recycling alternative is anticipated to adversely impact the crucial physical or chemical properties or either the Portland cement or the asphalt. To date, the performance of each product under analytical conditions is promising.

## Employee Health and Safety Implications

No significant adverse impacts or risks to workers or the public are anticipated to occur with either waste utilization alternative. The final results of emission measurements for the asphalt grinding operations at Hunter's Point have not been completed. Additionally, the source test information on the SWCC cement kiln exhaust is not currently available for evaluation. However, initial health risk estimates do not indicate any probability of adverse impacts to human health or the environment.

## State, Local, and Federal Law Compliance

Each demonstration was carefully planned by the participants and no activities were initiated until approval had been obtained from appropriate state and local agencies. However, the DTSC regulations for "Use Constituting Disposal" issues specifically related to recyclable wastes and asphalt concrete makes approval of this process slightly less difficult than the relatively new cement kiln reutilization technology.

Although recycling is not as effective as source reduction for waste minimization, both alternatives could provide hazardous waste generators with long term pollution prevention alternatives. This would assist industries with compliance with SB14 as well as other regulatory incentives for waste minimization.

## Releases and Discharges to All Media

Discharges to land, air, or water may potentially occur during handling transportation, or application during either alternative process. However, a reasonable comparison of the alternatives based on this criteria cannot be completed until final documentation regarding air emissions and leachability become available.

## 6.0 CONCLUSION

Substantial advances in research, development, and implementation of alternative technologies to hazardous waste disposal have been evidenced by the two demonstration projects presented in this paper. Clearly, these are two different yet successful approaches to the same problem; long term management and landfill diversion of hazardous wastes. Through beneficial utilization/recycling of a high volume industrial waste stream like ABM, opportunities for long term and permanent reductions in this and other waste streams can be more easily developed and implemented.

## 7.0 REFERENCES


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# THE FEASIBILITY OF RECYCLING SPENT HAZARDOUS SANDBLASTING GRIT INTO ASPHALT CONCRETE

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## SUMMARY

The recycling of spent sandblasting grit, commonly referred to as spent abrasive blast material (ABM), into asphalt concrete is being investigated by the U.S. Navy as an alternative to disposing the spent ABM in a landfill. This paper discusses issues related to the technical feasibility and regulatory acceptability of this concept. These issues include the chemical characterization of spent ABM, asphalt mix design criteria, the results of bench-scale tests, regulatory compliance issues, and a discussion of the advantages and disadvantages of recycling spent ABM into asphalt concrete. The merits of recycling versus some other option should be evaluated on a case-by-case basis.

## 1. BACKGROUND

The U.S. Navy generates spent ABM as a result of its ship-cleaning operations. The spent ABM generally contains low concentrations of metals from the paints, antifouling compounds, and other coatings that are applied to ship hulls. In the past, much of this spent ABM has been disposed in landfills -- nonhazardous waste landfills for spent ABM having very low metal concentrations and hazardous landfills for spent ABM containing relatively high metal contents. However, landfill disposal is being curtailed because of rising disposal costs, land ban restrictions imposed by the Resource Conservation and Recovery Act (RCRA), and the growing emphasis on waste minimization. Spent ABM appears to be a good candidate for recycling in asphalt concrete or other composites because its textural characteristics are compatible with the composites. Also, it was shown in a previous study that certain spent ABM does not respond well to stabilization/solidification technology to insolubilize the metallic constituents[1].

Battelle, along with the Naval Civil Engineering Laboratory and R&G Environmental Services (an environmental subsidiary of an asphalt production company), is investigating the feasibility of recycling spent

ABM into asphalt concrete for subsequent use in road and parking lot paving applications. Spent ABM from three different Navy bases in California is currently being studied. These bases include Hunters Point Annex (HPA) in Hunters Point, California; Mare Island Naval Shipyard (MINS) in Vallejo, California, and Long Beach Naval Shipyard (LBNS) in Long Beach, California. The spent ABM at HPA and LBNS is from previous ship-cleaning operations, while the grit from MINS is from an active sandblasting operation. Recycling by-product materials is encouraged by U.S. environmental regulatory agencies, as long as the practice does not represent "use constituting disposal" or sham recycling. This paper describes the status of these three ongoing investigations.

## 2. CHEMICAL CHARACTERIZATION OF SPENT ABM

Several different types of sandblasting grit exist. A complete listing is beyond the scope of this study, however, the different types include the following:

- A ground-up nickel smelting slag called "green diamond"
- A ground-up copper smelting slag referred to as "clean blast" or "clean slag"
- Beach sand
- Steel shot.

The spent ABM from MINS is "clean blast" and from HPA is beach sand. The spent ABM from LBNS is from an unknown source but texturally resembles beach sand with a small admixture of steel shot.

The spent ABM from all three sites has been chemically characterized for total and soluble (leachable) metal content, and the results are summarized in Table 1.

Note that the MINS unspent ABM contains approximately 500-2,000 mg/kg copper (before sandblasting) because this material is produced from copper smelter slag.

The total metals analyses is based on an extraction in hot concentrated mineral acid. The California Waste Extraction Test (WET) is a 48-hour batch leach test using a 0.4 M sodium citrate solution. The Toxicity Characteristic Leaching Procedure (TCLP) is an 18-hour batch leaching procedure using a dilute sodium acetate solution. Table 1 shows that the primary metallic contaminants in the ABM are copper and lead.

TABLE 1

Ranges of Metal Contents in Spent ABM

| | Total Content (mg/kg) | WET-Soluble Content (mg/L) | TCLP-Soluble Content (mg/L) |
|---|---|---|---|
| HPA | | | |
| Cu | 1,000 - 2,600** | 100 - 200** | * |
| Pb | 90 - 300 ** | 10 - 35** | 0.6 - 14 |
| Zn | 70 - 2,500 | 85 | * |
| Ni | 10 - 270 | 3.5 | * |
| Cr | 30 - 180 | 8 - 14 | <0.5 |
| MINS | | | |
| Cu | 1,500 - 7,500** | up to 300** | * |
| Pb | 15 - 120 | up to 9** | <3 |
| Zn | up to 1,000 | NA | * |
| Ni | up to 100 | NA | * |
| Cr | up to 25 | NA | |
| LBNS | | | |
| Cu | 2,000 - 4,800** | 50 - 165** | * |
| Pb | 30 - 630 | 2 - 43** | up to 9** |
| Zn | 640 - 760 | NA | * |
| Ni | 45 - 76 | NA | * |
| Cr | 78 - 84 | NA | up to 0.6 |

* Not a TCLP metal.
** Exceeds pertinent regulatory threshold and therefore defined as a hazardous waste.
NA = Not analyzed.

## 3. REGULATORY HAZARDOUS CRITERIA

ABM material that exceeds the Total Threshold Limit Concentration (TTLC) and/or Soluble Total Limit Concentration (STLC) threshold values for any metal is considered hazardous in the state of California. As a general rule, ABM that exceeds the TCLP threshold for any metal is referred to as exhibiting a "toxicity characteristic" and is considered hazardous by the U.S. Environmental Protection Agency (USEPA). If ABM exceeds either a TTLC or STLC but not a TCLP threshold, it is referred to as "California-only" hazardous -- that is, it is considered hazardous in the state of California but not by the USEPA. All of the ABM examined thus far in this study is either nonhazardous or "California-only" hazardous based on copper and/or lead TTLC and/or STLC exceedances (Table 1); none is "EPA-hazardous." Therefore, the material is regulated as hazardous waste only in the state of California and not by the USEPA.

Moreover, the hazardous ABM in this study is regulated only under California regulatory policy and rules, which as discussed below are in the process of being modified to permit the recycling of certain types of spent ABM currently defined as hazardous in the state of California.

Current California Department of Health Services (DOHS) policy on recycling spent ABM into asphalt concrete or other composites allows nonhazardous and certain types of hazardous (TTLC exceedance only) by-products such as ABM to be recycled. In September 1990, DOHS issued a draft modification to existing policy which, if implemented, will allow the recycling of a broader range of hazardous by-products, including those with STLC exceedances. Until the policy is formally promulgated, DOHS is reviewing recycling projects on a case-by-case basis, and issuing variances for recycling if certain conditions can be met. While a detailed discussion of these conditions is beyond the scope of this paper, the principal conditions are as follows:

A. The policy pertains to California-hazardous spent ABM only (EPA-hazardous may not be recycled). The asphalt concrete or other composite that the spent ABM is recycled into must conform to the California TTLC and STLC criteria.

B. The asphalt concrete must have suitable physical characteristics and must meet standard road paving structural criteria. Also, the spent ABM must contribute to the structural integrity of the concrete rather than detract from it.

C. A risk analysis must be performed to indicate that no significant risk is posed by either the recycling operation or the introduction of the spent ABM into the public domain.

This paper deals principally with requirements A and B above. Requirement C is being satisfied by conducting a risk analysis using standard DOHS and EPA risk analysis methodology.

## 4. BENCH-SCALE AND PILOT-SCALE TESTING

To comply with requirements A and B above, Battelle is coordinating bench-scale testing where the spent ABM is being incorporated into asphalt concrete and selected physical and chemical properties of the product are being measured. Compliance with the TTLC and STLC thresholds in the asphalt concrete as indicated in requirement A above can be achieved simply by using the appropriate proportion of spent ABM in the asphalt concrete product. For example, if the spent ABM exceeds the TTLC and/or STLC criteria by a factor of 5, then the TTLC or STLC criteria can be achieved by simply ensuring that the spent ABM comprises no greater than 20% (by weight) of the asphalt concrete product.

The physical or structural integrity criteria specified in requirement B above mandate that a series of bench-scale tests be performed, wherein asphalt concrete test specimens are produced in the laboratory under carefully controlled and documented procedures. First, loose asphalt is produced using specified proportions of spent ABM, aggregate of varying particle sizes, and asphalt (oil) content. Then the loose asphalt is heated and compressed into cylinders under simulated field compaction conditions. The cylinder is then tested for various physical parameters to determine the structural integrity of the asphalt concrete product.

The physical parameters of principal concern are as follows:

- Stabliometry (resistance to deformation due to load)
- Cohesiometry (cohesion)
- % voids (degree of compaction)
- Swell (water resistance).

After an asphalt concrete product that satisfies requirements A and B is produced in the bench-scale tests, we will conduct a pilot test at the hot plant to verify that the materials have a comparable physical integrity and can be produced at full-scale production.

## 5. TEST RESULTS

Based on the data collected to date, the asphalt concrete test samples containing spent ABM consistently meet all the structural integrity criteria except for stabilometry values, which are sometimes lower than the criterion of 35 for this project. (A stabliometry value of 30 corresponds to acceptable usage on light-traffic roads, 35 for medium-traffic roads, and 37 for heavy-traffic roads). Stabilometry values of 27-28 were produced when the spent ABM comprised approximately 50% of the asphalt concrete; however, this is a very high proportion of spent ABM, and these tests were run for research purposes only. At a more normal spent ABM loading proportion of 7-10% (by weight, approximately 10% less by volume), the stabilometry values increased to 31 to 46. The lower values in this range are acceptable for light-traffic roadways but do not meet the desired criteria of 35 for medium-traffic roadways. However, these tests were based on the use of the spent ABM in standard production-grade asphalt concrete at the facility performing the tests. It is possible to optimize the mix of ingredients to each specific spent ABM material using a procedure called centrifuge kerosene equivalent (CFE). These tests are currently being performed for each of the spent ABM materials in this study. The expected outcome is that the asphalt concrete resulting from the design mix specification will consistently meet or exceed the stabilometry criteria of 35.

## 6. DISCUSSION

### 6.1 Asphalt Integrity

Our bench-scale test data collected thus far suggest that a high quality asphalt concrete product can be produced at a spent ABM proportion of about 7-10% by weight. This is consistent with the results of a similar study for a different group of spent ABM, which demonstrated that a suitable quality asphalt concrete was produced at a spent ABM proportion of 10-20% by weight[2]. This latter study also showed that as the spent ABM content increased from 10 to 20%, the bitumen or oil requirement decreased by 0.5%, thereby reducing product cost. However, our data indicate that at 50% spent ABM, product quality drops to below the level needed for application on even light-traffic roadways.

6.2 Advantages of Recycling Spent ABM into Asphalt Concrete

1. The cost of recycling spent ABM into asphalt concrete is much lower than the cost of disposal; for example, at MINS the estimated cost of continued disposal in a hazardous waste landfill is $1,452K/year versus a maximum cost of $220K/year for the recycling option. This is based on an estimated annual production of 2,200 tons of spent ABM.
2. The recycling and reuse option is much higher in the hierarchy of hazardous waste management than disposal with or without treatment options. Furthermore, waste minimization credit may be given to the generator of the spent ABM because the spent ABM is not manifested as hazardous waste when it is transported to the hot plant for recycling.
3. The recycling option does not consume valuable landfill space, which can be reserved for higher-level hazardous wastes. Most spent ABM contains relatively low metal concentrations. The three grits in this study were hazardous in the state of California but were nonhazardous according to the EPA TCLP leaching test.
4. Some spent ABM contains an elevated aluminum content, which could lead to swelling and cracking if recycled into other construction materials such as cement or concrete.

6.3 Disadvantages of Recycling Spent ABM into Asphalt Concrete

1. If the spent ABM is hazardous, the material needs to be handled as a hazardous material (although not as a hazardous waste) and must comply with cognizant transportation and storage regulations. Also, cognizant regulatory requirements must be satisfied or a permit or variance may be required. In this study, these requirements include a bench-scale and pilot-scale test program and a risk analysis to show that the planned activity will not adversely affect human health and the environment.
2. Different types of spent ABM have varying particle sizes and differing capacities to absorb oil. Therefore, some bench-scale or laboratory testing and analysis are recommended to design the optimal mix of ingredients that will yield the highest stability product.

3. Certain constituents will interfere with the production of high quality asphalt. For example, high organic content (such as from paint chips and other organic coatings) is detrimental to stability, and sulfate may cause swelling upon contact with water.
4. If bench-scale testing is performed to design a mix, then it is important that the feeder sand/aggregate used in the bench-scale tests be the same as that used in the full-scale operation at the hot plant. Otherwise, the bench-scale test will not provide a true representation of the full-scale process. Feeder sand and aggregate are frequently purchased on the open market and physical characteristics such as particle size, shape, and density can vary significantly from batch to batch.

## REFERENCES

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2 California Office of Transportation. Copper Oxide Blasting Slag as an Aggregate in Asphalt Concrete, final report memorandum to R.N. Doty on research project dated 2 August 1989, File Number 631140-30040, 1989.

# APPENDIX B

## DETAILED TABULATION OF ANALYTICAL RESULTS FOR SANDBLASTING GRIT

TABLE B-1. ANALYTICAL DATA ON UNTREATED HUNTERS POINT SAMPLES, NOS. 1 TO 12

| Sample Identification | Metals, mg/kg | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cu | Pb | Sb | As | Ba | Be | Cd | Cr[(a)] | Co | Mo | Ni | Se | V | Zn |
| HP-1 | 1,900 | 250 | <8 | 4.7 | 310 | 0.23 | <0.5 | 110 | 9 | <5 | 45 | <0.5 | 26 | 1,400 |
| HP-1 Dup | 1,900 | 280 | <8 | 4.5 | 280 | 0.24 | <0.5 | 110 | 8 | <5 | 45 | <0.5 | 27 | 1,600 |
| HP-2 | 2,100 | 230 | <8 | 8.0 | 300 | 0.37 | <0.5 | 180[(b)] | 13 | <5 | 110 | <0.5 | 39 | 890 |
| HP-3 | 2,100 | 210 | 11 | 8.8 | 320 | 0.29 | <0.5 | 160[(b)] | 10 | <5 | 66 | <0.5 | 31 | 2,500 |
| HP-4 | 1,100 | 160 | <8 | 4.5 | 100 | 0.10 | <0.5 | 44 | 2 | 8 | 25 | <0.5 | 11 | 68 |
| HP-5 | 990 | 120 | <8 | 4.0 | 250 | 0.23 | <0.5 | 88 | 20 | <5 | 270 | <0.5 | 26 | 860 |
| HP-6 | 1,300 | 110 | <8 | 4.3 | 60 | 0.05 | <0.5 | 26 | 2 | 29 | 10 | <0.5 | 5.7 | 650 |
| HP-7 | 1,900 | 220 | <8 | 4.4 | 270 | 0.19 | <0.5 | 100 | 8 | <5 | 58 | <0.5 | 22 | 78 |
| HP-8 | 1,400 | 170 | <8 | 6.5 | 150 | 0.20 | <0.5 | 72 | 8 | <5 | 90 | <0.5 | 24 | 78 |
| HP-9 | 2,300 | 330 | <8 | 4.2 | 270 | 0.11 | <0.5 | 69 | 4 | <5 | 32 | <0.5 | 13 | 1,500 |
| HP-10 | 2,100 | 160 | <8 | 7.8 | 270 | 0.26 | <0.5 | 130 | 11 | 6 | 140 | <0.5 | 29 | 880 |
| HP-11 | 2,300 | 330 | <8 | 5.2 | 340 | 0.16 | <0.5 | 130 | 6 | 9 | 78 | <0.5 | 19 | 1,400 |
| HP-12 | 2,500 | 240 | <8 | 3.5 | 280 | 0.12 | <0.5 | 78 | 5 | 6 | 58 | <0.5 | 15 | 1,900 |

(a) Total Cr.
(b) Cr(VI) data: HP-2 = 14 mg/kg; HP-3 = 8.4 mg/kg.

TABLE B-2. ANALYTICAL DATA ON UNTREATED HUNTERS POINT SAMPLES, NOS. 13 TO 27

| Sample Identification | Metals, (mg/kg) | |
|---|---|---|
| | Cu | Pb |
| HP-13 | 1,900 | 240 |
| HP-14 | 1,900 | 170 |
| HP-14 Dup | 1,600 | 180 |
| HP-15 | 1,600 | 330 |
| HP-16 | 1,700 | 170 |
| HP-17 | 1,800 | 200 |
| HP-18 | 1,600 | 150 |
| HP-19 | 2,000 | 250 |
| HP-20 | 1,600 | 86 |
| HP-21 | 2,100 | 180 |
| HP-22 | 2,000 | 200 |
| HP-23 | 1,600 | 180 |
| HP-24 | 1,700 | 210 |
| HP-25 | 2,600 | 190 |
| HP-26 | 1,700 | 170 |
| HP-27 | 1.2 | <5 |

[a] Samples codes are as follows:

1. Samples 1 to 8 and 25 collected from the 0- to 1-m (0- to 3-ft) level [after eliminating the top 8 cm (3 in.)]. Sample 25 is a blind replicate of Sample 1.
2. Samples 9 to 16 and 26 collected from the 1- to 2-m (3- to 6-ft) level. Sample 26 is a blind replicate of Sample 10.
3. Samples 17 to 24 collected from the 2- to 3-m (6- to 9-ft) level.
4. Sample 27 is a blank [reagent silicon dioxide ($SiO_2$) sand].

## APPENDIX C

## HAZARDOUS WASTE MANAGEMENT PROGRAM – MANAGEMENT MEMO "USE CONSTITUTING DISPOSAL"

# HAZARDOUS WASTE MANAGEMENT PROGRAM

## MANAGEMENT MEMO

**MANAGEMENT MEMO #: EO-95-010-MM**

**TITLE: USE CONSTITUTING DISPOSAL**

**AFFECTED PROGRAMS:** Hazardous Waste Management Program
Site Mitigation Program

**ISSUE:**

The Department of Toxic Substances Control (DTSC) is now developing regulations to address the "use constituting disposal" restriction as it pertains to recyclable materials that are non-RCRA hazardous wastes in section 25143.2(e)(2) of the Health and Safety Code (HSC). A "non-RCRA" waste is hazardous waste that is regulated in California but is not a Resource Conservation and Recovery Act (RCRA) waste. A RCRA hazardous waste is any waste identified as a hazardous waste in Part 261, Subchapter I, Chapter 1 of Title 40 of the Code of Federal Regulations (40 CFR). The "use constituting disposal" restriction affects the eligibility of recyclable materials for the exclusions and exemptions provided under HSC section 25143.2. The purpose of this management memo is to provide interim guidance on how to interpret "use constituting disposal," and therefore determine if a waste is subject to regulation pursuant to HSC section 25143.2(e)(2), until the regulations are adopted.

**BACKGROUND:**

HSC section 25143.2 addresses exclusions and exemptions for recyclable materials that are managed in a specified manner. Note that a recyclable material is defined as a hazardous waste that is capable of being recycled.[1] HSC section 25143.2 also lists conditions under which the recyclable materials must be fully regulated as hazardous wastes, regardless of the exclusions from classification as a waste and the exemptions from facility permitting requirements granted in this section. One such condition is when the materials are "used in a manner constituting disposal." This restriction is addressed separately for RCRA wastes and non-RCRA wastes.

Under California law, there is no definition for "use constituting disposal." The U.S. Environmental Protection Agency (U.S. EPA) has defined "use constituting disposal" to mean placing recyclable materials or products derived from recyclable

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[1] Ref. HSC section 25120.5.

materials on the land.[2] Under federal regulations, recyclable materials that are used in a manner constituting disposal are subject to regulation as solid wastes. At the same time, the U.S. EPA does not currently regulate products containing recyclable materials that are placed on the land if the recyclable materials have undergone a chemical reaction in producing the product so as to be physically inseparable from the product and the product meets the applicable treatment standards (or applicable prohibition levels where no treatment standards have been established) in subpart D, part 268, 40 CFR.

Since 1987, the DTSC has applied a set of criteria to recyclable materials placed on the land in determining whether or not such materials are "used in a manner constituting disposal." If these criteria are met, the recyclable materials are not regulated pursuant to HSC section 25143.2(e)(2) and may be eligible for the exclusions and exemptions under HSC section 25143.2 (b), (c) or (d). **The DTSC's criteria apply only to non-RCRA wastes.** The DTSC is currently writing regulations to address the issue of recyclable materials that are placed on the land ("use constituting disposal"). This management memo clarifies the criteria applied by the DTSC pending adoption of these regulations.

**ACTION:**

The following, **which applies only to non-RCRA wastes**, is the DTSC's present interpretation of the "use constituting disposal" restriction, i.e., of which recyclable materials are subject to regulation, in HSC section 25143.2(e)(2). This interpretation applies only until regulations addressing recyclable materials used in a manner constituting disposal or placed on the land are adopted.

A recyclable material that is placed on the land or used to produce a product which is placed on the land is regulated pursuant to HSC section 25143.2(e)(2) unless all applicable criteria listed below are met.

1. This criterion applies to situations where the recyclable material is used as an ingredient in the manufacture of a product. Hazardous constituents in the recyclable material whose concentrations are greater than or equal to the

[2] Ref. 50 Federal Register 618, January 4, 1985, and 40 CFR 266.20.

regulatory Soluble Threshold Limit Concentrations (STLCs)[3] shall have chemically reacted or become physically bound so as not to leach from the product containing the recyclable material. Specifically, the hazardous constituents shall not leach out in concentrations that would exceed the applicable STLC, once the effect of dilution by other ingredients (as explained below) has been taken into account.

In order to meet this requirement, the following procedures must be used to evaluate the recyclable material and the product:

(a) Sampling and analysis:

(1) Sampling shall be conducted according to the sampling methods described in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition, 1986, or one of the sampling methods listed in Appendix I, Chapter 11, Division 4.5, Title 22, California Code of Regulations (22 CCR); and

(2) Analysis shall be conducted according to the Waste Extraction Test (WET), Appendix II, Chapter 11, Division 4.5, 22 CCR, or an alternative test method approved pursuant to 22 CCR section 66260.21

(b) In order to demonstrate that the hazardous constituents in the recyclable material are bound in the product so that they would not exceed the applicable STLC, even when eliminating the effect of dilution by other ingredients, the following calculations must be used.

The concentration of the hazardous constituents in the final product, as determined by the WET, must be multiplied by the dilution factor inherent in combining the recyclable material with other materials. The dilution factor is calculated by dividing the weight of the final product made with the recyclable material by the weight of the recyclable material used in the product, or

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[3] As set forth in sections 66261.24(a)(2)(A) and (a)(2)(B), Division 4.5, Title 22 of the California Code of Regulations (22 CCR).

$$\frac{\text{weight of final product}}{\text{weight of recyclable material}} = \text{dilution factor}$$

If the ingredients in the product that are not recyclable materials contain the same hazardous constituents present in the recyclable material, the hazardous constituents in the ingredients that are not recyclable materials may be subtracted from the concentration of hazardous constituents in the final product, adjusted for dilution.

The final calculation of the hazardous constituents present in the product, as determined by taking into account the effects of dilution and, where applicable, the effects of hazardous constituents in ingredients that are not recyclable materials, must be less than the applicable STLC.

The following is an example of how these calculations can be done.

A ton of spent sandblast grit, which is hazardous due to a mean soluble lead concentration of 12 mg/L, is combined with nineteen tons of other aggregate and asphalt to produce twenty tons of asphaltic concrete. The dilution factor is thus 20 (twenty tons of final product, including the recyclable material, divided by the original one ton of recyclable material). The asphaltic concrete is then subjected to the WET and yields mean results for lead of 0.05 mg/l. This number is then multiplied by the dilution factor, 20, for a result of 1.00 mg/l. The aggregate that is not a recyclable material was tested with the WET and found to have a concentration of 0.05 mg/l lead. This concentration can be subtracted from 1 mg/l to give you 0.95 mg/l. This final calculation does not exceed the STLC for lead of 5 mg/l and therefore meets the criterion.

2. A recyclable material used as a substitute for a commercial product or a product containing a recyclable material shall not contain constituents that cause the product to exhibit hazardous characteristics pursuant to Chapter 11, Division 4.5, CCR 22, other than those constituents that are also found in the same or greater concentrations in a comparable commercial product. The only exception to this requirement is if the person claiming an exclusion obtains

the DTSC's written concurrence prior to using the recyclable material that:

(a) the concentrations of hazardous constituents greater than those present in a comparable commercial product improve the quality of the product made from the recyclable material and do not increase the hazards to public health or the environment of that product; or

(b) if no comparable commercial product exists, the hazardous constituents in the recyclable material that cause the product to exhibit a characteristic of a hazardous waste are beneficial to the product and do not cause the product to pose a threat to public health or the environment.

3. The recyclable material must be used beneficially, as demonstrated by both of the following conditions:

(a) Prior to use, the recyclable material and the product containing that material must each be certified by a qualified independent engineer registered in the state of California[4] to meet the applicable standards or specifications for the intended use of the recyclable material or product of the American Society for Testing and Materials (ASTM), the American Association of State Highway and Transportation Officials (AASHTO), the American National Standards Institute (ANSI), the Uniform Building Code (UBC), or the standards of a government agency having jurisdiction over the construction applications of that recyclable material or product. A nationally recognized industry standard, other than those mentioned, may be used with the prior written approval of the DTSC.

(b) There shall be no indications of sham recycling, including, but not limited to, use of the recyclable material or a product containing a recyclable material in excess of what is necessary to accomplish its function, handling of the recyclable material in a manner inconsistent with the economic value of the

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[4] By "qualified independent engineer", we mean an engineer whose registration (e.g., civil, mechanical, structural, etc.) is appropriate for the product she/he is certifying and who is not an employee of the person claiming an exclusion or exemption pursuant to HSC 25143.2.

material, or insufficient use of the recyclable material to accomplish its function.

Non-RCRA hazardous wastes managed according to the applicable criteria above will not be regulated pursuant to HSC 25143.2(e) and may therefore qualify for the exclusions and exemptions in HSC section 25143.2 if the requirements of a specific exclusion or exemption are met and none of the other provisions of subdivision (e) apply.

Examples of recyclable materials used in products placed on the land are spent sandblast grit, contaminated soils, foundry sands, ash, and demolition wastes, which may be used, among other things, as asphalt treated road base, landfill cover material, or aggregate in Portland cement concrete or an asphaltic concrete.

Use of recyclable materials as fertilizer, soil amendment, agricultural mineral, or an auxiliary soil and plant substance, with or without combination with other materials, is not covered by this management memo and is regulated separately.[5] Used oil is also not covered by this management memo.[6]

This management memo will stay in effect until the promulgation of regulations regarding management requirements for recyclable materials that are placed on the land, i.e., used in a manner constituting disposal, or until it is replaced by a subsequent management memo or DTSC policy.

**DISTRIBUTION:**

Cal/EPA Access Bulletin Board System
Hazardous Waste Management Program Policy Mailing List

**ATTACHMENTS:** None

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[5] Ref. Article 8, Chapter 16, 22 CCR.

[6] Ref. Article 13, Chapter 6.5, Division 20 of the Health and Safety Code.

**CONTACT:**

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State Regulatory Program Division
Hazardous Waste Management Program HQ-10
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Phone: (916)322-1003/CALNET 492-1003

8/18/95
Date

Ted N. Rauh
Deputy Director

## APPENDIX D-1

## CALIFORNIA DEPARTMENT OF TOXIC SUSTANCES CONTROL CONCURRENCE
## FOR USE OF SANDBLASTING GRIT
## IN THE MANUFACTURE
## OF ASPHALTIC CONCRETE

STATE OF CALIFORNIA—ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, Governor

DEPARTMENT OF TOXIC SUBSTANCES CONTROL
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA 95812-0806
(916) 322-1003

October 14, 1993

Dr. Jeffrey L. Means
Battelle
505 King Avenue
Columbus, Ohio 43201-2693

USE OF SANDBLASTING GRIT IN THE MANUFACTURE OF ASPHALT CONCRETE

Dear Dr. Means:

This is in response to your letter of October 6, 1993, requesting our concurrence that the proposed use of spent sandblasting grit from the U.S. Navy's shipyard at Hunters Point Annex can qualify for a recycling exclusion according to the provisions of section 25143.2, Chapter 6.5, Division 20 of the Health and Safety Code (HSC).

Your letter states that the spent sandblasting grit, which exceeds our Soluble Threshold Limit Concentrations (STLC's) for lead and copper, will be used in the production of asphalt concrete by Orland Asphalt. Your letter also states that the state guidelines for using a hazardous waste in a product that is placed on the land, contained in our interpretation of the "use constituting disposal" restriction pursuant to HSC section 25143.2(e)(2), will be followed. To support this contention, you referred to documentation already provided to us from a pilot project using sandblasting grit in the production of asphalt concrete at Hunters Point Annex and repeated the tables showing the concentrations of lead and copper in the sandblasting grit and in the asphalt concrete made from the sandblasting grit. Furthermore, your letter contends that the sandblasting grit is not a RCRA waste and does not fail our Total Threshold Limit Concentrations (TTLC's).

Based on the information you have provided us, we concur that the Hunters Point spent sandblasting grit used in the manufacture of asphalt concrete would be excluded from classification as a waste pursuant to HSC section 25143.2(d)(5), if the following conditions are met:

- o The sandblasting grit is not treated prior to introduction in the asphalt manufacturing process except by the procedures specified in subparagraphs (A) through (H) of HSC section 25143.2(d)(5);

- None of the provisions of HSC section 25143.2(e) supersede the exclusion. Use of the Hunters Point sandblasting grit in the manufacture of asphalt concrete must continue to meet the guidelines contained in our interpretation paper of the "use constituting disposal" restriction pursuant to HSC section 25143.2(e)(2);

- The recordkeeping and related requirements of HSC section 25143.2(f) must be observed; and

- The requirements pertaining to labeling, storage and business plans in HSC section 25143.9 must be observed.

In addition, although not a condition of the exclusion, HSC section 25143.10 requires that any person recycling more than 100 kilograms of a hazardous wastes per month under the claim to a recycling exclusion in HSC section 25143.2 must report certain information to the local health officer every two years (contact the local health department or environmental health department for more information and the appropriate reporting forms).

I am enclosing copies of our hazardous waste recycling laws containing the sections referred to in this letter and our interpretation paper for the "use constituting disposal restriction." If you have any questions, please contact me at (916) 322-1003.

Sincerely,

Jessie Schnell

Jessie Schnell
Program Coordination and
Policy Development Branch

Enclosures

cc: Region 1/SACRAMENTO

*EXCERPTS FROM*

# CALIFORNIA'S HAZARDOUS WASTE RECYCLING LAWS

*EFFECTIVE JANUARY 1, 1993*

The following definitions and requirements are excerpts from the California Hazardous Waste Control Law, Chapter 6.5, Division 20, Health and Safety Code (HSC). The statutory definitions reproduced here should help you in understanding the exemptions and exclusions applicable to recyclable materials specified in HSC section 25143.2. Information on how to obtain a complete copy of the law and/or regulations is on the last page of this document.

## Definitions

25113.

(a) "Disposal" means either of the following:

(1) The discharge, deposit, injection, dumping, spilling, leaking, or placing of any waste so that the waste or any constituent of the waste is or may be emitted into the air or discharged into or on any land or waters, including groundwaters, or may otherwise enter the environment.

(2) The abandonment of any waste.

(b) The amendment of the section made at the 1989-90 Regular Session of the Legislature does not constitute a change in, but is declaratory of, the existing law.

(Amended by Stats. 1989, Ch. 1436.)

25117.

(a) **"Hazardous waste"** means either of the following:

(1) A waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either:

(A) Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness.

(B) Pose a substantial present or potential hazard to human health or environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

(2) A waste which meets any of the criteria for the identification of a hazardous waste adopted by the department pursuant to Section 25141.

(b) "Hazardous waste" includes, but is not limited to, RCRA hazardous waste.

(c) Unless expressly provided otherwise, the term "hazardous waste" shall be understood to also include extremely hazardous waste and acutely hazardous waste.

(Amended by Stats. 1989, Ch. 1436.)

25117.9. **"Non-RCRA hazardous waste"** means all hazardous waste regulated in the state, other than RCRA hazardous waste, as defined in Section 25120.2. A hazardous waste regulated in the state is presumed to be RCRA hazardous waste, unless it is determined, pursuant to regulations adopted by the department, that the hazardous waste is a non-RCRA hazardous waste.

(Amended by Stats. 1991, Ch. 1126)

25120.2. **"RCRA hazardous waste"** means all waste identified as a hazardous waste in Part 261 (commencing with Section 261.1) of Subchapter I of Chapter 1 of Title 40 of the Code of Federal Regulations and appendixes thereto.

(Added by Stats. 1989, Ch. 1436.)

25120.5. **"Recyclable material"** means a hazardous waste that is capable of being recycled, including, but not limited to, any one of the following:

(a) A residue.

25120.5. (cont.)

(b) A spent material, including, but not limited to, a used or spent stripping or plating solution or etchant.

(c) A material that is contaminated to such an extent that it can no longer be used for the purpose for which it was originally purchased or manufactured.

(d) A byproduct listed in the regulations adopted by the department as "hazardous waste from specific sources" or "hazardous waste from nonspecific sources."

(e) Any retrograde material that has not been used, distributed, or reclaimed through treatment by the original manufacturer or owner by the later of the following dates:

(1) One year after the date when the material became a retrograde material.

(2) One year after the material is returned to the original manufacturer.
(Amended and renumbered by Stats. 1988, Ch. 1631.)

25121. **"Recycled material"** means a material which is used or reused, or reclaimed.
(Amended by Stats. 1988, Ch. 1631.)

25121.5.
(a) **"Retrograde material"** means any hazardous material which is not to be used, sold, or distributed for use in an originally intended or prescribed manner or for an originally intended or prescribed purpose and which meets any one or more of the following criteria:

(1) Has undergone chemical, biochemical, physical, or other changes due to the passage of time or the environmental conditions under which it was stored.

(2) Has exceeded a specified or recommended shelf life.

(3) Is banned by law, regulation, ordinance, or decree.

(4) Cannot be used for reasons of economics, health or safety, or environmental hazard.

25121.5. (cont.)

(b) "Retrograde material" does not include material designated in regulations adopted by the department as included in a category which the department shall title "Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof", if either of the following conditions is met:

(1) The material is used in a manner constituting disposal and the material is not normally used in a manner constituting disposal.

(2) The material is burned for energy recovery and the material is not normally burned for energy recovery.

(Amended by Stats. 1988, Ch. 1631.)

25122.55.

(a) **Used or spent etchants, stripping solutions, and plating solutions** are spent, contaminated, or used material for purposes of this chapter.

(b) Used or spent etchants, stripping solutions, and plating solutions which meet a characteristic established by or are listed by the Environmental Protection Agency or the department as a hazardous waste and are transported from the site where they are produced, and transferred to an unrelated or unaffiliated person for any purpose, are subject to the requirements of this chapter which apply to hazardous waste unless the department waives any specific provision of this chapter pursuant to Section 25143. Nothing in this section exempts any used or spent etchant, stripping solution, or plating solution from any other requirement of this chapter.

(Added by Stats. 1985, Ch. 1191.)

25123.5. "Treatment" means any method, technique, or process which changes or is designed to change the physical, chemical, or biological character or composition of any hazardous waste or any material contained therein, or removes or reduces its harmful properties or characteristics for any purpose. "Treatment" does not include the removal of residues from manufacturing process equipment for the purposes of cleaning that equipment.

(Amended by Stats. 1992, Ch. 1345.)

25124.

(a) **"Waste"** means any solid, liquid, semisolid, or contained gaseous discarded material that is not excluded by this chapter or by regulations adopted pursuant to this chapter.

(b) A discarded material is any material which is any of the following:

(1) Relinquished, as specified in subdivision (c).

(2) Recycled, as specified in subdivision (d).

(3) Considered inherently waste like, as specified in the regulations adopted by the department.

(c) A material is a waste if it is relinquished by being any of the following:

(1) Disposed of.

(2) Burned or incinerated.

(3) Accumulated, stored, or treated, but not recycled, before, or in lieu of, being relinquished by being disposed of, burned, or incinerated.

(d) A material is a waste if it is recycled, or accumulated, stored, or treated before recycling, except as provided in Section 25143.2.

(e) A material is a waste if it poses a threat to public health or the environment and meets either, or both, of the following conditions:

(1) It is mislabeled or not adequately labeled, unless the material is correctly labeled or adequately labeled within 10 days after the material is discovered to be mislabeled or inadequately labeled.

(2) It is packaged in deteriorated or damaged containers, unless the material is contained in sound or undamaged containers within 96 hours after the containers are discovered to be deteriorated or damaged.

(Amended by Stats. 1992, Ch. 1344.)

## Recyclable Materials, Exclusions and Exemptions

25143.2.

(a) Recyclable materials are subject to the requirements of this chapter and the regulations adopted by the department to implement this chapter which apply to hazardous wastes, unless the department issues a variance pursuant to Section 25143, or except as provided otherwise in subdivision (b), (c), or (d) or the regulations adopted by the department pursuant to Sections 25150 and 25151. For the purposes of this section, recyclable material does not include infectious waste.

(b) Except as otherwise provided in subdivisions (e), (f) and (g), recyclable material which is managed in accordance with Section 25143.9 and is or will be recycled by any of the following methods shall be excluded from classification as a waste:

(1) Used or reused as an ingredient in an industrial process to make a product, if the material is not being reclaimed.

(2) Used or reused as a safe and effective substitute for commercial products, if the material is not being reclaimed.

(3) Returned to the original process from which the material was generated, without first being reclaimed, if the material is returned as a substitute for raw material feedstock, and the process uses raw materials as principal feedstocks.

(c) Except as otherwise provided in subdivision (e), any recyclable material may be recycled at a facility which is not authorized by the department pursuant to the applicable hazardous waste facilities permit requirements of Article 9 (commencing with Section 25200) if either of the following requirements is met:

(1) The material is a petroleum refinery waste containing oil which is converted into petroleum coke at the same facility at which the waste was generated, unless the resulting coke product would be identified as a hazardous waste under this chapter. A waste subject to this paragraph is exempt from this chapter to the same extent the waste is exempt from subsections (q), (r), and (s) of Section 6924 of Title 42 of the United States Code.

(2) The material meets all of the following conditions:

(A) The material is recycled and used at the same facility at which the material was generated.

(B) The material is recycled within 90 days of its generation.

(C) The material is managed in accordance with all applicable requirements for generators of hazardous wastes under this chapter and regulations adopted by the department.

(d) Except as otherwise provided in subdivisions (e), (f), (g), and (h), recyclable material which meets the definition of a non-RCRA hazardous waste in Section 25117.9, is managed in accordance with Section 25143.9, and meets or will meet any of the following requirements is excluded from classification as a waste:

(1) The material can be shown to be recycled and used at the site where the material was generated.

(2) The material qualifies as one or more of the following:

(A) The material is a product, which has been processed from a hazardous waste, or which has been handled, at a facility authorized by the department pursuant to the facility permit requirements of Article 9 (commencing with Section 25200) to process or handle the material, if the product meets both of the following conditions:

(i) The product does not contain constituents, other than those for which the material is being recycled which render the material hazardous under regulations adopted pursuant to Sections 25140 and 25141.

(ii) The product is used, or distributed or sold for use, in a manner for which the product is commonly used.

(B) The material is a petroleum refinery waste containing oil which is converted into petroleum coke at the same facility at which the waste was generated, unless the resulting coke product would be identified as a hazardous waste under this chapter.

(C) The material is oily waste, used oil, or spent nonhalogenated solvent which is managed by the owner or operator of a refinery which is processing primarily crude oil and which is not subject to permit requirements for recycling of used oil, or a public utility, or a corporate subsidiary, corporate parent, or subsidiary of the same corporate parent of the refinery or public utility, and which meets all of the following requirements:

(i) The material is either burned in an industrial boiler, an industrial furnace, an incinerator, or a utility boiler which complies with all applicable federal and state laws, or is recombined with normal process streams to produce a fuel.

(ii) The material is managed at the site where it was generated; managed at another site owned or operated by the generator, a corporate subsidiary of the generator, a subsidiary of the same entity of which the generator is a subsidiary, or the corporate parent of the generator; or, if the material is generated in the course of oil or gas exploration or production, managed by an unrelated refinery receiving the waste through a common pipeline.

(iii) The material does not contain constituents other than those for which the material is being recycled which render the material hazardous under regulations adopted pursuant to Sections 25140 and 25141.

(D) The material is a fuel which is removed from a fuel tank, is either contaminated with water or by nonhazardous debris, of not more than 2 percent by weight, including, but not limited to, rust or sand, or a fuel unintentionally mixed with an unused petroleum product, and is transferred to, and processed into a fuel at, a refinery which processes primarily crude oil.

25143.2(d) (cont.)

(3) The material is transported between locations operated by the same person who generated the material, if the material is recycled at the last location operated by that person and all of the conditions of clauses (i) to (vi), inclusive, of subparagraph (A) of paragraph (4) are met. If requested by the department or by any law enforcement official, a person handling material subject to this paragraph shall, within 15 days of the request, supply documentation to show that the requirements of this paragraph have been satisfied.

(4) (A) The material is transferred between locations operated by the same person who generated the material, if the material is to be recycled at an authorized offsite hazardous waste facility and if all of the following conditions are met:

(i) The material is transferred by employees of that person in vehicles under the control of that person or by a registered hazardous waste hauler under contract to that person.

(ii) The material is not handled at any interim location.

(iii) The material is not held at any publicly accessible interim location for more than four hours unless required by other provisions of law.

(iv) The material is managed in compliance with the requirements of this chapter and the regulations adopted pursuant to this chapter prior to the initial transportation of the material and after the receipt of the material at the last location operated by that person. Upon receipt of the material at the last location operated by that person, the material shall be deemed to have been generated at that location.

(v) All of the following information is maintained in an operating log at the last location operated by that person:

(I) The name and address of each generator location contributing material to each shipment received.

(II) The quantity and type of material contributed by each generator to each shipment of material.

(III) The destination and intended disposition of all material shipped offsite or received.

(IV) The date of each shipment received or sent offsite.

The log shall be kept for at least three years after receipt of the material at that location.

(vi) If requested by the department, or by any law enforcement official, a person handling material subject to this paragraph shall, within 15 days of the request, supply documentation to show that the requirements of this paragraph have been satisfied.

(B) For purposes of paragraph (3) and subparagraph (A) of paragraph (4), "person" also includes corporate subsidiary, corporate parent, or subsidiary of the same corporate parent.

(C) Persons which are a corporate subsidiary, corporate parent, or subsidiary of the same corporate parent, and which manage recyclable materials under paragraph (3) or subparagraph (A) of paragraph (4), are jointly and severally liable for any activities excluded from regulation pursuant to this section.

(5) The material is used or reused as an ingredient in an industrial process to make a product, if the material is not being treated before introduction to that process except by one or more of the following procedures, and if any discharges to air from the following procedures do not contain constituents which are hazardous wastes pursuant to the department's regulations and comply with applicable air pollution control laws:

(A) Filtering.

(B) Screening.

(C) Sorting.

(D) Sieving.

(E) Grinding.

(F) Physical or gravity separation, without the addition of external heat or any chemicals.

(G) pH adjustment.

(H) Viscosity adjustment.

(6) The material is used or reused as a safe and effective substitute for commercial products, if the material is not being treated except by one or more of the following procedures, and if any discharges to air from the following procedures do not contain constituents which are hazardous wastes pursuant to the department's regulations and comply with applicable air pollution control laws:

(A) Filtering.

(B) Screening.

(C) Sorting.

(D) Sieving.

(E) Grinding.

(F) Physical or gravity separation, without the addition of external heat or any chemicals.

(G) pH adjustment.

(H) Viscosity adjustment.

(7) The material is a chlorofluorocarbon or hydrochlorofluorocarbon compound or a combination of chlorofluorocarbon or hydrochlorofluorocarbon compounds, is being reused or recycled, and is used in heat transfer equipment, including, but not limited to, mobile air conditioning systems, mobile refrigeration, and commercial and industrial air conditioning and refrigeration systems, used in fire extinguishing products, or contained within foam products.

(e) Notwithstanding subdivisions (b), (c), and (d), all of the following recyclable materials are hazardous wastes and subject to full regulation under this chapter, even if the recycling involves use, reuse, or return to the original process as described in subdivision (b), or even if the recycling involves activities or materials described in subdivisions (c) and (d):

(1) Materials which are a RCRA hazardous waste, as defined in Section 25120.2, used in a manner constituting disposal, or used to produce products that are applied to the land including, but not limited to, materials used to produce a fertilizer, soil amendment, agricultural mineral, or an auxiliary soil and plant substance.

(2) Materials which are a non-RCRA hazardous waste, as defined in Section 25117.9, and used in a manner constituting disposal or used to produce products that are applied to the land as a fertilizer, soil amendment, agricultural mineral, or an auxiliary soil and plant substance. The department may adopt regulations to exclude materials from regulation pursuant to this paragraph.

(3) Materials burned for energy recovery, used to produce a fuel, or contained in fuels, except materials exempted under paragraph (1) of subdivision (c) or excluded under subparagraph (B), (C), or (D) of paragraph (2) of subdivision (d).

(4) Materials accumulated speculatively.

(5) Materials determined to be inherently wastelike pursuant to regulations adopted by the department.

(6) Used or spent etchants, stripping solutions, and plating solutions, which are transported to an offsite facility operated by a person other than the generator and which are either of the following:

(A) The etchants or solutions are no longer fit for their originally purchased or manufactured purpose.

(B) If the etchants or solutions are reused, the generator and the user cannot document that they are used for their originally purchased or manufactured purpose without prior treatment.

(7) Used oil, as defined in subdivision (a) of Section 25250.1, unless one of the following applies:

(A) The used oil is excluded under subparagraph (B) or (C) of paragraph (2) of subdivision (d) or under paragraph (4) of subdivision (d) of this section, under subdivision (e) of Section 25250.1, or under Section 25250.3.

(B) The used oil is used or reused on the site where it was generated or is excluded under paragraph (3) of subdivision (d) of this section and, in either situation, is not any of the following:

(i) Used in a manner constituting disposal or used to produce a product that is applied to land.

(ii) Burned for energy recovery or used to produce a fuel, unless the used oil is excluded under subparagraph (B) or (C) of paragraph (2) of subdivision (d).

(iii) Accumulated speculatively.

(iv) Determined to be inherently wastelike pursuant to regulations adopted by the department.

(f) (1) Any person who manages a recyclable material under a claim that the material qualifies for exclusion or exemption pursuant to this section shall provide, upon request, to the department, the Environmental Protection Agency, or any local agency or official authorized to bring an action as provided in Section 25180, all of the following information:

(A) The name, street and mailing address, and telephone number of the owner or operator of any facility that manages the material.

(B) Any other information related to that person's management of the material requested by the department, the Environmental Protection Agency, or the authorized local agency or official.

25143.2(f) (cont.)

(2) Any person claiming an exclusion or an exemption shall maintain adequate records to demonstrate to the satisfaction of the requesting agency or official that there is a known market or disposition for the material, and that the requirements of any exemption or exclusion pursuant to this section are met.

(3) For purposes of determining that the conditions for exclusion from classification as a waste pursuant to this section are met, any person, facility, site, or vehicle engaged in the management of a material under a claim that the material is excluded from classification as a waste pursuant to this section shall be subject to Section 25185.

(g) For purposes of Chapter 6.8 (commencing with Section 25300), recyclable materials excluded from classification as a waste pursuant to this section are not excluded from the definition of hazardous substances in subdivision (g) of Section 25316.

(h) Used oil that fails to qualify for exclusion pursuant to subdivision (d) solely because the used oil is a RCRA hazardous waste, may be managed pursuant to subdivision (d) if the used oil is also managed in accordance with Part 260 (commencing with Section 260.1) to Part 270 (commencing with Section 270.1), inclusive, of Subchapter I of Chapter 1 of Title 40 of the Code of Federal Regulations.
(Amended by Stats. 1992, Ch. 1344)

25143.3. The Environmental Protection Agency regulations regarding spent sulfuric acid as set forth in Section 261.4 (a) (7) of Title 40 of the Code of Federal Regulations (50 Fed. Reg 665) are the regulations of the department and shall remain in effect until the department adopts regulations regarding this subject. It is the intent of the Legislature that the regulations adopted by the department be at least equivalent to, and in substantial conformance with that Section 261.4 (a) (7). Further, it is the intent of the Legislature that the department may define in the regulations the term "spent sulfuric acid" as it deems necessary to avoid sham recycling, as described on page 638 of Volume 50 of the Federal Register by the Environmental Protection Agency.
(Added by Stats. 1985, Ch. 1594.)

25143.9. A recyclable material shall not be excluded from classification as a waste pursuant to subdivision (b) or (d) of Section 25143.2, unless all of the following requirements are met:

(a) If the material is held in a container or tank, the container or tank is labeled, marked, and placarded in accordance with the department's hazardous waste labeling, marking, and placarding requirements which are applicable to generators, except that the container or tank shall be labeled or marked clearly with the words "Excluded Recyclable Material" instead of the words "Hazardous Waste," and manifest document numbers are not applicable.

(b) The owner or operator of the business location where the material is located has a business plan that meets the requirements of Section 25504, including, but not limited to, emergency response plans and procedures, as described in subdivision (b) of Section 25504, which specifically address the material or that meet the department's emergency response and contingency requirements which are applicable to generators of hazardous waste.

(c) The material shall be stored and handled in accordance with all local ordinances and codes, including, but not limited to, fire codes, governing the storage and handling of the hazardous material. If a local jurisdiction does not have an ordinance or code regulating the storage of the material, including, but not limited to, an ordinance or code requiring secondary containment for hazardous material storage areas, then the material shall be stored in tanks, waste piles, or containers meeting the department's interim status regulations establishing design standards applicable to tanks, waste piles, or containers storing hazardous waste.

(d) If the material is being exported to a foreign country, the person exporting the material shall meet the requirements of Section 25162.1.
(Amended by Stats. 1991, Ch. 1173)

25143.10.

(a) Except as provided in subdivisions (e) and (f), any person who recycles more than 100 kilograms per month of recyclable material under a claim that the material qualifies for exclusion or exemption pursuant to Section 25143.2 shall, on or before July 1, 1992, and every two years thereafter, provide to the local health officer or other local public officer authorized to implement this chapter pursuant to Section 25180, all of the following information, using the format established pursuant to subdivision (d), in writing:

25143.10(a) (cont.)

(1) The name, site address, mailing address, and telephone number of the owner or operator of any facility that recycles the material.

(2) The name and address of the generator of the recyclable material.

(3) Documentation that the requirements of any exemptions or exclusions pursuant to Section 25143.2 are met, including, but not limited to, all of the following:

(A) Where a person who recycles the material is not the same person who generated the recyclable material, documentation that there is a known market for disposition of the recyclable material and any products manufactured from the recyclable material.

(B) Where the basis for the exclusion is that the recyclable material is used or reused to make a product or as a safe and effective substitute for a commercial product, a general description of the material and products, identification of the constituents or group of constituents, and their approximate concentrations, which would render the material or product hazardous under the regulations adopted pursuant to Sections 25140 and 25141, if it were a waste, and the means by which the material is beneficially used.

(b) The governing body of a city or county may adopt an ordinance or resolution pursuant to Section 510 to pay for the actual expenses of the activities carried out by local health officers or other local public officers pursuant to subdivision (a).

(c) If a person who recycles material under a claim that the material qualifies for exclusion or exemption pursuant to Section 25143.2 is not the same person who generated the recyclable material, the person who recycles the material shall, on or before July 1, 1992, and every two years thereafter, provide a copy of the information required to be submitted pursuant to subdivision (a) to the generator of the recyclable material.

(d) The person providing the information required by subdivision (a) shall use a format developed by the California Conference of Directors of Environmental Health in consultation with the department. The department shall distribute the format to local health officers or other local public officers authorized to implement this chapter pursuant to Section 25180.

25143.10. (cont.)

(e) A recyclable material generated in a product or raw material storage tank, a product or raw material transport vehicle or vessel, a product or raw material pipeline, or in a manufacturing process unit or an associated nonwaste treatment manufacturing unit is not subject to the requirements of this section, until the recyclable material exits the unit in which it was generated, unless the unit is a surface impoundment, or unless the material remains in the unit for more than 90 days after the unit ceases to be operated for manufacturing, storage, or transportation of the product or raw material.

(f) A local health officer or other local public officer authorized to implement this chapter pursuant to Section 25180 may exempt from subdivision (a) any person who operates antifreeze recycling units or solvent distillation units, where the recycled material is returned to productive use at the site of generation, or may require less information than that required under subdivision (a) from such a person.
(Added by Stats. 1991, Ch. 715)

## ORDERING CALIFORNIA'S HAZARDOUS WASTE LAWS AND REGULATIONS:

### Hazardous Waste Control Law

A copy of California's Hazardous Waste Control Law (Chapters 6.5-6.98, Division 20, Health and Safety Code), Item No. 7540-958-1016-6, can be bought by contacting:

Department of General Services
P.O. Box 1015
North Highlands, CA 95660
(916) 973-3700 (information only; no phone orders)

### Hazardous Waste Control Regulations

A copy of California's hazardous waste control regulations (Division 4.5, Title 22, California Code of Regulations), order code 22 04 000, can be bought by contacting:

Barclays Law Publishers
File No. 42021, P.O. Box 60000
San Francisco, CA 94160-2021
(415) 244-6611 (phone orders accepted)

### Excerpts from Used Oil Recycling Laws

Resource Recovery Unit
Program Coordination and Policy Development Division
Department of Toxic Substances Control
P.O. Box 806
Sacramento, CA 95812-0806
(916) 323-6042

DRAFT

WORKING PAPER



Section 25143.2(e) of the California Health and Safety Code (HSC) lists restrictions to the statutory exemptions for recyclable materials in Sections 25143.2 (b), (c) and (d), HSC. Subsections 25143.2(e)(1) and (e)(2) exclude from exemption "materials used in a manner constituting disposal, or used to produce products that are applied to the land ....".

INTERPRETATION:

The following applies to non-RCRA wastes. A recyclable material is used in a manner constituting disposal if it is applied to land or used to produce a product which is applied to land unless it meets all of the criteria listed below.

1. The recyclable material must be mixed with other materials.

2. After mixing the recyclable material with other materials, it must be demonstrated that hazardous constituents failing the S.T.L.C. criteria of the California Code of Regulations (CCR), Title 22, Section 66261.24(a)(2), have chemically reacted so as to be physically inseparable from the resultant product (incorporation of recyclable material into asphalt, asphaltic concrete or concrete is deemed to conform to this criterion). A test of this requirement is to perform the Waste Extraction Test (W.E.T.), Appendix II, Chapter 11, Title 22, CCR, on the final product. The concentration of the hazardous constituent in the extract must be multipied by the dilution factor inherent in combining the recyclable material with the other materials. Background levels of hazardous constituents added by ingredients other than the recyclable material may be subtracted from the final W.E.T. concentration. The final W.E.T. concentration should be less than the applicable S.T.L.C.

3. After mixing the recyclable material with other materials, it must be demonstrated that hazardous constituents failing the T.T.L.C. criteria of CCR, Title 22, Section 66261.24(a)(2) are entrapped so as to prevent significant release of particulate material.

4. After mixing the recyclable material with other substances, it must be demonstrated that the recyclable material adds no hazard to the recycling operation or the final product.

5. The final product must be available for use by the general public.

An activity involving non-RCRA wastes that meets all of the above criteria is not judged to be used in a manner constituting disposal and therefore might be eligible for the recycling exemptions in Section 25143.2 (b), (c) and (d), HSC. For RCRA wastes, a waste derived product meeting the above criteria may not be regulated;

however, all recyclable materials used in a product applied to the land must be managed as hazardous wastes per Sections 266.21, 266.22 and 266.23, Title 40 of the Code of Federal Regulations. Also, although the waste derived product may not be regulated under RCRA, it must meet applicable treatment standards.

Use of recyclable materials as fertilizer, soil amendment, agricultural mineral, or an auxiliary soil and plant substance (with or without combination with other materials) is not covered by this discussion and is regulated under Article 8, Chapter 16, Title 22, CCR.

APPENDIX D-2

BAY AREA AIR QUALITY MANAGEMENT DISTRICT
AIR PERMIT REVIEW

# BAY AREA AIR QUALITY MANAGEMENT DISTRICT



August 30, 1993

Dr. Jeffrey L. Means
Battelle
505 King Avenue
Columbus, OH 43201-2693

Subj: Hunters Point Sandblasting Grit Project

Dear Dr. Means:

The Bay Area Air Quality Management District has reviewed your request for an experimental exemption for the sandblasting grit milling and sieving operations at the Treasure Island Naval Station, Hunters Point Annex prior to transportation of the grit to an offsite asphalt plant for recovery. As this project is occurring at a federal facility under the provisions of CERCLA, it is the District's opinion that no exemption or permits are need for this project, provided that certain standards of operation are maintained.

These requirements may be met by ensuring that the regulations of the Bay Area Air Quality Management District are followed at all times. Additionally, if air contaminant concentrations exceed those estimated in the "Work Plan for Recycling Sandblasting Grit Into Asphalt Concrete, Hunters Point Annex" (July 1993), the District must be notified, and additional health risk screens may be required.

If you have any questions on this matter, please contact Ms. Catherine Fortney, Air Quality Engineer, at (415) 749-4671.

Very truly yours,

John A Swanson

John A. Swanson
Director of Permit Services

cc: Catherine Fortney
Scott Lutz
Jim Tomich
HPA File

939 ELLIS STREET • SAN FRANCISCO, CALIFORNIA 94109 • (415) 771-6000 • FAX (415) 928-8560

# APPENDIX D-3

## CALIFORNIA REGIONAL WATER QUALITY BOARD – CENTRAL VALLEY REGION RESPONSE TO GLENN COUNTY PLANNING DEPARTMENT

STATE OF CALIFORNIA - ENVIRONMENTAL PROTECTION AGENCY

PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD -
CENTRAL VALLEY REGION
3443 ROUTIER ROAD, SUITE A
SACRAMENTO, CA 95827-3098
PHONE: (916) 255-3000
FAX: (916) 255-3015

18 October 1993

Christy Leighton
Glenn County Planning Department
125 South Murdock
Willows, CA 95988

***CONDITIONAL USE PERMIT NO. 93-10, JAXON ENTERPRISES - GLENN COUNTY***

We received a copy of a letter dated 14 October 1993, (copy enclosed) from Jessie Schnell of the Department of Toxic Substances Control (DTSC) to Batelle of Ohio, regarding the recycling of sandblasting grit in the manufacture of asphalt concrete. Since DTSC concurs with the determination that the sandblasting grit is not a waste, we see no need for further involvement by the Regional Water Quality Control Board, provided the conditions specified by DTSC are complied with.

If you have any questions, please call Arnie Inouye at (916) 255-3138.

William J. Marshall

William J. Marshall, Chief
Chapter 15 Unit

WJM

Enclosure

cc w/o encl: Maria Salomon, Department of Toxic Substances Control, Sacramento
Greg Lindholm, Glenn County Health Department, Glenn County
Chris Kraft, Jaxon Enterprises, Redding
✓ Jeffrey Means, Battelle, Columbus, Ohio

**APPENDIX D-4**

**CALIFORNIA AIR RESOURCES BOARD**
**RISK MODELLING RESULTS**

State of California

MEMORANDUM

To : Kevin Tokunaga
Glenn County Air Pollution
Control District
P.O. Box 351
720 North Colusa Street
Willows, CA 95988

Date : October 28, 1993

Subject : Hunter's Point Grit/
Asphalt Orland
Project

Jim Behrmann

From : Jim Behrmann, Manager
Toxics Program Support Section
Stationary Source Division
Air Resources Board

The purpose of this memo is to confirm your telephone conversation of October 25 with Ruth Tomlin of my staff regarding the results of our review of the risk screening modeling for the grit handling on the Orland project. The PTPLU2 model results indicate that the maximum hourly concentration (worst case) for lead would be expected to be 2.4E-4 ug/m3 at a distance of 23 meters downwind, well below the monthly standard of 1.5 ug/m3, and not expected to cause any adverse human health effects. A copy of the model printout is enclosed, and includes the source and meteorological conditions used in the model.

If you have any questions, or need further assistance, please call me at (916) 322-8273, or Ruth Tomlin at (916) 327-5620.

Enclosure

cc: Ruth Tomlin, ARB (w/Enclosure)
Rick Stewart, Glenn County APCD (w/Enclosure)
Jessie Schnell, DTSC (w/Enclosure)
√Jeff Means, Ph.D., Battelle (w/Enclosure)

**APPENDIX E-1**

**ORLAND ASPHALT BUSINESS PLAN**

COUNTY OF GLENN
STATE OF CALIFORNIA

DIVERSIFIED FARMING
"Where Water Is King"

JOHN BENOIT
Planning Director

GLENN COUNTY
PLANNING DEPARTMENT

125 South Murdock
WILLOWS, CALIFORNIA 95988
(916) 934-6540

RECEIVED
MAY 02 1994

April 28, 1994

Jaxon Enterprises
P.O. Box 994248
Redding, CA 96099-4248

Dear Ms. Baker:

RE: Conditional Use Permit #93-10 Sand Blasting Grit

On April 28, 1994, the Glenn County Technical Advisory Committee approved the operation plan you presented. A copy of the plan is enclosed with this letter. Thank you for your compliance with the Conditions of Approval.

Yours truly,

Christy Leighton

Christy Leighton,
Senior Planner

Enclosure

ORLAND ASPHALT
INTERSTATE 5 AT COUNTY ROAD 7
ORLAND, CA 95936
1-800-570-7087



## BUSINESS PLAN FOR ORLAND ASPHALT

This business/operations plan was developed in accordance with California's Hazardous Waste Control Law, Chapter 6.5, Division 20, Health and Safety Code (HSC) and with the Conditional Use Permit #93-10 granted to Jaxon Enterprises. This business/operations plan will be subject to the review and approval by the Technical Advisory Committee prior to the start of this project in accordance with item 27 of the Conditional Use Permit #93-10.

### PROGRAM COORDINATORS

Dr. Jeff Means - Battelle 614-424-5442 or 614-486-5810

Jeff Health - U.S. Navy Civil Engineering Lab 805-982-1657 or 805-985-7498

Generator of Sandblasting Grit - United States Navy Shipyard, Hunters Point Annex, Naval Station at Treasure Island

Both the U.S. Navy and Battelle Memorial Institute will be providing coordination and oversight through project completion, and will ensure that all project-related activities are coordinated in compliance with the work plan and relevant regulatory requirements. Orland Asphalt will comply with the reporting requirements of the Health and Safety Code 25143.10.

A representative from either the U.S. Navy or Battelle will be present at the beginning of the project to review transportation of the sandblasting grit, storage facilities and to ensure that the start up of the project is according to specifications. A representative of either agency will intermittently take samples of the asphalt concrete while it is being placed on the paving job as well as be present at the end of the entire project to oversee the clean up and decontamination of the site.

### Responsible Parties at Site

Bill Sliger - Plant Manager 800-570-7087
Leo Mack - Asphalt Plant Operator 916-224-0411

### Jaxon Enterprises Contact Persons

Bill Sliger - 800-570-7087
W. Jaxon Baker - 916-241-2112
Laura Baker - 916-241-2112

Transportation of Sandblasting from Hunters Point Annex to Orland Asphalt

According to Conditional Use Permit #93-10 item 28, the material shall not be shipped into Glenn County until assurances by Caltrans or other public agencies are secured that the public agency will use the material.

The sandblasting grit will be transported from HPA to Orland Asphalt in covered trucks by a certified hazardous materials driver. The truck drivers will be provided documentation of the chemical composition of the grit, directions to Orland Asphalt, and a list of agencies to contact in case of an accident.

Storage of Sandblasting Grit

The storage area shall be constructed to prevent seepage and runoff according to the details provided below. A detailed site plan, to be approved by the Technical Advisory Committee shall be submitted prior to construction of the concrete pad.

The sandblasting grit will be stored on a 80' by 80' asphalt concrete pad with an impervious liner installed in the asphalt to prevent seepage of any substances. The pad will be composed of 12" of compacted 3/4 aggregate base paved on top with 2/10ths of 3/4 AR 4000 Asphaltic Concrete. The impervious liner will then be installed and paved with an additional 2/10ths of 3/4 AR 4000 Asphaltic Concrete. The grit pile will be covered with 10 mil visquine to prevent infiltration of water and dust dispersion. Three sides of the asphaltic concrete pad will be walled by concrete to prevent spillage. Crushed gravel, 3/8th in size will be utilized to hold the visquine cover in place. The container will be labeled with the words "Excluded Recyclable Material."

The storage pad will be located approximately 30 feet from the designated feeder. This will facilitate the most efficient, and least hazardous travel pattern for the loader. Travel from pad to pile will be approximately 85' in reverse and 65' forward to feed bin.

Testing Procedures on Asphalt Containing Sandblasting Grit

Battelle, the U.S. Navy and/or CalTrans will be collecting samples of the asphalt concrete while it is being placed on the job. The asphalt concrete will be tested for: (a) analysis of metals content to determine compliance with Cal EPA "Use Constituting Disposal" (UCD) policy; and (b) physical properties on the asphalt to determine long-term durability.

Emergency Response Procedures at Orland Asphalt

Orland Asphalt will ensure compliance with OSHA worker safety requirements when the grit is in use at the hot plant. Workers will be briefed on the health and safety hazards of the sandblasting grit and trained on proper handling procedures and procedures to prevent exposure.

Training will be provided in accordance with California's Hazardous Waste Control Law section 25504 which includes safety procedures to be followed in the event of a release or threatened release as described in the following section.

To minimize the possibility of mixing of materials, a storage bin will be dedicated for use of temporary storage of sandblasting grit only. a loader will also be dedicated for transportation of the sandblasting grit only during jobs using the sandblasting grit.

The composition of the sandblasting grit does not make it a material that poses an immediate threat to any person if there were to be a spill.

Procedures in Case of a Spill

In the event of a spill of the sandblasting grit at the Orland Asphalt site the area will first be covered and secured and Environmental Health will be notified. If the spill is a manageable size, it will be picked up with the designated loader and placed on a plastic tarp. The area where the spill occurred will be scraped at least 1" into the surface of the ground to ensure all of the sandblasting grit has been recovered.

Any ground where a spill has occurred will be sampled for remaining sandblasting grit. The sandblasting grit will then either be incorporated into the asphalt according to this plan or disposed of as a hazardous waste. If the spill exceeds Orland Asphalt's capability to manage, the area will be secured and the U.S. Navy and Battelle Institute will be consulted as to proper handling of spill.

Mix Design

The recyclable sandblasting grit can be incorporated into asphalt concrete as a normal component of the asphalt concrete mixture. The sandblasting grit will not be more than 5% of the total concrete asphalt mixture.

A 25 ton feed hopper equipped with a variable speed control for proper percentage blend will be designated for use with the sandblasting grit. This will feed onto an existing collecting conveyor with balance of Stony Creek rock and sand proportioned as to job mix requirements.

## Notification to Glenn County Officials

Requirements as to agencies to be informed and record keeping as required in Conditional Use Permit #93-10, will be implemented prior to, during and after shipment of asphaltic concrete containing sandblasting grit.

The Glenn County Planning Department, Air Pollution Control District and the Health Department will be provided with written documentation of each load of sandblasting grit received at the site and written documentation of the location of each shipment of asphalt containing the sandblasting grit on Wednesday of each week for the preceding week as detailed in Conditional Use Permit #93-10, item 25.

Bill Sliger, plant manager at Orland Asphalt will notify GCAPCD at least 24 hours prior to each batch process of asphalt incorporation the sandblasting grit.

Orland Asphalt will comply with the reporting requirements of the Health and Safety Code.

## Handling of Sandblasting Grit

The sandblasting grit will be handled with special precautions. As stated previously, a loader will be designated for the transportation of sandblasting grit only during those jobs incorporating the grit into the asphalt mixture. When the sandblasting grit arrives on site it will be weighed in and dumped on the storage pad. Water will be readily available to control dust if the material is dry. (NOTE: CalTrans' sand equivalent test resulted in a 66 reading indicating the sandblasting grit is almost as clean from clay/dust as state spec concrete sand) The material will be wet down before it is covered.

Near the end of the job, the loader bucket will be cleaned and any remaining sandblasting grit will be incorporated into the asphalt. This will reduce the opportunity for mixing of the sandblasting grit with the pure sand.

During the jobs where the sandblasting grit is being incorporated into the asphalt, a hopper will be designated for the sandblasting grit only. Near the end of the job, the hopper will be cleaned and any remaining sandblasting grit will be incorporated into the asphalt.

The path between the sandblasting grit storage area and the hopper will be kept clear during those days when the sandblasting grit is being incorporated into the asphalt. At the end of the job, any areas where spillage of the sandblasting grit may have occurred will be scraped up at least 1" or more below the surface of the ground and incorporated into the asphalt.

The area in which the sandblasting grit is stored will be marked as a restricted area with the pad containing the grit marked "Excluded Recyclable Material."

The loader will begin loading the sandblasting grit from the south side of the pile. This will help prevent any wind erosion as the wind commonly blows from the north. The loading procedure will entail rolling back the visquine cover, loading the sandblasting grit and recovering the pile with the visquine and crushed gravel.

**APPENDIX E-2**

**CONDITIONAL USE PERMIT**
**FOR SANDBLASTING GRIT RECYCLING**

GLENN COUNTY
PLANNING DEPARTMENT

125 South Murdock
WILLOWS, CALIFORNIA 95988
(916) 934-6540

DIVERSIFIED FARMING
"Where Water Is King"

JOHN BENOIT
*Planning Director*

October 5, 1993

**PLANNING DEPARTMENT STAFF REPORT**

MEETING DATE: October 14, 1993

TO: Glenn County Technical Advisory Committee

FROM: Christy Leighton, Senior Planner

SUBJECT: **Conditional Use Permit #93-10, Jaxon Enterprises, Use of Sand Blasting Grit.**

Attachments:
1. Information from Jaxon Enterprises (Ivory)
2. Information from Battelle (Blue)
2. Negative Declaration (Green)
3. Conditions of Approval (Pink)
4. Location Map

## I. INTRODUCTION:

Jaxon Enterprises as applied for a Conditional Use Permit #93-10 to allow incorporation of 3200 tons of recycled sand blasting grit from Hunter's Point Naval Base into the production of Asphalt Concrete.

This project is located south of County Road "7", west of Interstate 5, north of Orland. APN: 44-160-018, 44-230-002, 005.

Staff recommends that the Planning Commission grant CUP #93-10 a Negative Declaration with the Findings and Mitigation Measures listed. Staff also recommends the Planning Commission approve CUP #93-10 with the Findings and Conditions of Approval as stated in the Staff Report.

## II. PROJECT DESCRIPTION:

1. APPLICANT:

Jaxon Enterprises
P.O. Box 9944248
Redding, CA 96099-4248

2. LOCATION:

South of County Road "7", west of Interstate 5, north of Orland.

3. APN:

44-160-018, 44-230-002,005.

4. GENERAL PLAN DESIGNATION:

"Agriculture General", twenty acre minimum parcel size.

5. ZONING:

"AE-20", Exclusive Agricultural, twenty acre minimum parcel size.

6. PROPOSAL:

Conditional Use Permit to allow incorporation of 3200 tons of recycled sand blasting grit from Hunter's Point Naval Base into the production of Asphalt Concrete to be used by Caltrans.

## III. HISTORY:

1. On February 18, 1957, this land was zoned "A-1" by the adoption of Ordinance No. 352.

2. On November 27, 1973, this land was zoned from "A-1" to "A-2" (Exclusive Agriculture, 20 acre minimum parcel size) by the adoption of Ordinance No. 581 and Sectional District Map No. NE '73 (A).

3. On August 27, 1974, part of this land was zoned from "A-2" to "DF" (Designated Floodway) by the adoption of Ordinance No. 614 and Sectional District Map No. NE-'74 (C).

4. On July 18, 1984, the Glenn County Planning Commission approved Conditional Use Permit #84-10 and Reclamation Plan for August Martin; however, this permit is now void.

5. On January 6, 1987, the Board of Supervisors upheld an appeal on the Planning Commission approval of Conditional Use Permit #86-15 for Jaxon Enterprises for gravel extraction, crushing, screening, hot plant, office and sign.

6. This Conditional Use Permit #86-15 was renewed by the Glenn County Planning Commission in 1987, 1988, 1989, 1990, 1991 and 1993. This Permit is now in effect until January 6, 1997.

7. On July 15, 1992, the Glenn County Planning Commission approved an amendment of CUP #86-15 for the construction and operation of a soil remediation facility in addition to the previously permitted activities at the site.

8. On August 18, 1993, the Planning Commission granted a two-year extension for the construction and operation of a soil remediation system to July 15, 1995.

## IV. ENVIRONMENTAL SETTING:

### 1. EXISTING USES AND IMPROVEMENTS:

The site is developed with gravel crushing and screening equipment, a hot plant, office and sign for the gravel business as allowed by Conditional Use Permit #86-15.

### 2. SURROUNDING ZONING AND LAND USE:

North: This area is zoned "AE-20" (Exclusive Agricultural, 20 acre minimum parcel size). This area is designated "Agriculture General" (twenty acre minimum parcel size) on the General Plan. This area is used for small farms.

East: Interstate-5 if the eastern boundary of the site.

West: This area is zoned "AE-20" (Exclusive Agricultural, 20 acre minimum parcel size). This area is designated "Agriculture General" (twenty acre minimum parcel size) on the General Plan. This area is used for agriculture.

South: This area is zoned "AP-80" (Agricultural Preserve, 80 acre minimum parcel size). This area is designated "Agriculture General" (twenty acre minimum parcel size) on the General Plan. This area is used for agriculture.

### 3. FLOOD ZONE:

According to Federal Flood Insurance Rate Map 0165B, this area is in Flood Zone "C", not subject to flooding, and Flood Zone "A", subject to flooding.

## V. ENVIRONMENTAL ANALYSIS:

To perform environmental review, an Environmental Checklist is used to determine significant adverse environmental effects. The checklist addresses various categories of environmental impacts, such as earth, air, water, plant life, animal life, noise, light and glare, land use, natural resources, risk of upset, population, housing, transportation/circulation, public services, energy, utilities, human health, aesthetics, recreation and cultural resources. Within each category are considerations to check either "yes" , "no" or "maybe" for environmental effects.

The Initial Study Checklist form has been completed and is available for review at the Planning Department. The Initial Study Checklist form has been used as a basis for identifying significant adverse environmental effects and is incorporated into this report by reference. All items are checked "no" except for the following items. The following discussion explains each item checked "yes" or "maybe" and lists appropriate mitigation measures.

**2a. Will the proposal result in substantial air emission or deterioration of ambient air quality?**

The answer to this question was "maybe".

**3e. Will the proposal result in discharge into surface waters, or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?**

The answer to this question was "maybe".

**10a. Will the proposal involve a risk of an explosion or the release of hazardous substances (including, but not limited to, oil, pesticides, chemicals or radiation) in the event of an accident or upset conditions?**

The answer to this question was "maybe".

**14f. Will the proposal have an effect upon or result in a need for new or altered governmental services in any of the following areas: other governmental services?**

The answer to this question was "maybe".

**17a. Will the proposal result in creation of any health hazard or potential health hazard (excluding mental health)?**

The answer to this question was "maybe".

**17b. Will the proposal result in exposure of people to potential health hazards?**

The answer to this question was "maybe".

The primary concern regarding this project is the safety of the sand blasting grit and the safety of the asphalt including the sand blasting grit. The applicant has provided documentation that this material is not a hazardous substance and that it will remain encapsulated within the asphalt and that it will not harm the groundwater or the air or other aspects of the environment.

Mitigation Measures are as follows (numbers refer to Condition of Approval Numbers):

6. That the applicant shall provide the Glenn County Planning Department with proof of fiscal responsibility whether by establishing a net worth of more than 250 million dollars ($250,000,000.00) or by filing a Certificate of Insurance in the amount of one million dollars ($1,000,000.00). Said insurance coverage shall be maintained for the term of the permit. The Certificate of Insurance shall be filed with the Glenn County Planning Department within thirty (30) days from the date of approval of this Conditional Use Permit.

10. That the applicant shall secure a permit from any other County or State agencies that are necessary. Copies of said permits shall be filed with the Glenn County Planning Department.

11. That the permit holder shall comply with the terms and conditions of this permit unless more restrictive conditions have been included in other required permits in which case the more restrictive shall apply.

12. That the permit holder shall conduct all project related operations in a manner that safeguards employees and the public and shall comply with the State Health and Safety Code.

15. That the applicant shall inform the County Planning Department where the asphalt material containing the sand blasting grit shall be used prior to any storage or use of sand blasting grit at the site.

20. That the storage area for the sand blasting grit shall fully contain the material and shall be completely covered.

21. That sand blasting grit shall be stored out of the flood plain.

22. That if the sand blasting grit incorporation into asphalt operation ceases for ninety (90) consecutive days, all unused sand blasting grit shall be removed within the next ninety (90) days.

25. That the applicant shall provide the Glenn County Planning Department, Glenn County Air Pollution Control District, and the Glenn County Health Department with written documentation of each load of sand blasting grit received at the site and written documentation of the location of each shipment of asphalt containing the sand blasting grit on Wednesday of each week for the preceding week. This documentation shall contain the following information:

a) Date, time, quantity of recyclable material received;

b) Date, time quantity destination, exact location, copy of invoice document, and name of supervisor of project when recycled asphalt is shipped.

## VI. AGENCIES CONTACTED:

California Department of Fish and Game
California Department of Fish and Game, Dave Gardner
California Division of Mines and Geology
California Regional Water Quality Control Board
California State Reclamation Board
Caltrans
Glenn County Agriculture Commissioner
Glenn County Air Pollution Control District
Glenn County Building Inspector
Glenn County Cooperative Extension
Glenn County Department of Public Works
Glenn County Health Department
Glenn County Resource Conservation District
Orland Rural Fire Protection District
Orland Superintendent of Schools
Pacific Bell
Pacific Gas and Electric Company

## VII. AGENCY RESPONSE:

### A. STATE RECLAMATION BOARD:

*The Reclamation Board has no jurisdiction over tentative parcel maps or changes in zoning; however, the project is located in or adjacent to the Stony Creek Designated Floodway over which the Board has jurisdiction. The project proponent should be notified that a Reclamation Board permit is required prior to start of any proposed work within the Designated Floodway not currently permitted by the Board, as required by Section 8710 of the California Water Code.*

### B. GLENN COUNTY AIR POLLUTION CONTROL DISTRICT:

*The applicant shall:*

*1. Submit a Risk Assessment for evaluation by the Glenn County Air Pollution Control District (GCAPCD). The risk assessment criteria will be based on process data made available by applicant. The specific information required includes:*

*a) dilution factor of grit*
*b) quantity of recycled asphalt to be processed per hour, per day*
*c) number of hours of production per day, per week*
*d) distance, in meters of residences adjacent to site*

*2. Not sell, in any of its variant forms, recycled asphalt from this project for use within Glenn County. (Subject to roadgrinding test results and TAC approval).*

*3. Not exceed 20% opacity while processing recycled asphalt.*

*4. Notify (GCAPCD) 24 hours prior to each batch process of recycled asphalt.*

*5. Provide GCAPCD with* ***weekly*** *documentation containing the following information:*

*a) Date, time, quantity of recyclable material received;*
*b) Date, time quantity destination, exact location, copy of invoice document, and name of supervisor of project when recycled asphalt is shipped.*

*6. Shall inform GCAPCD of the nature and origin of the "dilution" sand to be mixed with the contaminated grit.*

*7. Shall reimburse GCAPCD and Health Department for requisite data recording and monitoring.*

*8. Shall keep materials in question covered to prevent runoff and protection from wind gusts.*

## VIII. PLAN AND CODE REQUIREMENTS:

1. APPLICABLE PLANS:

Glenn County General Plan:

The existing operation at the site conforms to the General Plan and has an approved Conditional Use Permit #86-15.

2. **APPLICABLE CODES:**

a) GLENN COUNTY CODE, TITLE 19, ZONING ORDINANCE:

Section 19.36.040 S. of the Glenn County Code allows "Commercial mineral extractions" in the "AE-20" Zone. This Conditional Use Permit is in addition to Conditional Use Permit #86-15 which has already been approved at the site.

## IX. RECOMMENDATION:

A. NEGATIVE DECLARATION:

Staff recommends that the Planning Commission grant this Conditional Use Permit #93-10 a Negative Declaration with the following findings :

1. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will be compatible with the existing Conditional Use Permit for gravel extraction and processing.

2. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will be a benefit to the County by using recycling and bringing income to the County.

3. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will not have any potential adverse effect on wildlife resources because this use will be combined with an existing Conditional Use Permit.

4. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans may have an adverse impact on air quality, water quality, and traffic but these impacts will be mitigated by the following stated mitigation measures and no other significant adverse impacts are expected.

## B. PROJECT:

Staff recommends that the Planning Commission approve Conditional Use Permit #93-10 with the following Findings and with the Conditions of Approval attached:

1. That the granting of this Conditional Use Permit #93-10 to allow the use of sand blasting grit in asphalt is consistent with the Glenn County General Plan because it will make use of the County's resources.

2. That the site for this Conditional Use Permit to allow the use of sand blasting grit in asphalt is adequate in size and shape to accommodate this use.

3. That the Conditional Use Permit to allow the use of sand blasting grit in asphalt will not, under the circumstances of this case, be detrimental to the health, safety or general welfare of persons residing or working in the vicinity because the conditions of approval will regulate the use of the site.

4. That a Negative Declaration has been granted for this project (CUP #93-10).

5. That this use is conditionally permitted by Section 19.36.040 S. of the Glenn County Code.

# X. SAMPLE MOTIONS:

## A. NEGATIVE DECLARATION:

I move that the Planning Commission find that, on the basis of the Initial Study prepared for CUP #93-10 by the Planning Department, will not have a significant adverse impact on the environment; and therefore, a Negative Declaration shall be issued with the Findings and Mitigation Measures listed.

## B. PROJECT:

I move that the Planning Commission find that the Conditional Use Permit #93-10 applied for by Jaxon Enterprises, does meet the requirements of Section 19.12.040 A, B, C and D of the Glenn County Code and that the Planning Commission has reviewed and considered the Negative Declaration which was adopted for the project and that the Conditional Use Permit be granted subject to the Conditions of Approval attached with the Findings listed in the Staff Report.

# ORLAND ASPHALT

September 30, 1993

John Benoit
Glenn County Planning Department
125 South Murdock Avenue
Willows, CA 95988

Dear Mr. Benoit,

In response to your question regarding how we intend to maintain the integrity of our asphalt not containing sandgrit residue, I would like to explain our daily cleaning procedure at Orland Asphalt.

The silos at Orland Asphalt are self-cleaning and self-polishing silos. Everyday at the end of our production we activate the cleaning mechanism which opens the dump gate where all of the residue asphalt is "washed" from the inside of the silo. This promotes a cleaner product and aids in the flow of the asphalt during the loading of trucks.

As an additional safety measure to ensure there is no residue of sandgrit in asphalt not intended to contain sandgrit we plan to run a "clean" batch of asphalt as our last load on the days we are running the sandgrit asphalt. As the inside of the silos are slick, most of the sandgrit asphalt will already be evacuated when we run the "clean" asphalt. We believe this last load of "clean" asphalt will work as an extra cleansing agent in the cleaning procedure.

If you have any further questions, please do not hesitate to call.

Very truly yours,

Laura K. Baker

Laura K. Baker

PHONE: 916-241-2932 / FAX: 916-243-0787
P.O. BOX 994138, REDDING, CA 96099-4138

**ORLAND ASPHALT**

October 5, 1993

Christy E. Leighton
Senior Planner, Glenn County Planning Department
125 South Murdock
Willows, CA 95988

Dear Christy,

We are presently in correspondence with Joe Young from Caltrans regarding the use of sandblasting grit asphalt in our future Caltrans project at Orland. At this time we have all positive reactions from Caltrans although we have not yet obtained a commitment letter from them. For this reason we would like to be issued the use permit with the contingency that we obtain such a letter from Caltrans.

To answer some questions that have come up we would like to present some of the facts and procedures we will be using on any project we have involving this sandblasting grit.

First, the total amount of spent sandblasting grit is approximately 3,200 tons and is located at Hunters Point Annex Naval Station on Treasure Island. We will not be receiving all of the sandblasting grit at one time. The rate of trucking the sand from Hunters Point will key off the consumption of the sandblasting grit at the asphalt plant. We will have no more than 1500 tons of the sandblasting grit stored on our site at any one time.

The first stage of the project will be the trucking of the sandblasting grit from Hunters Point to Orland Asphalt. As previously stated, the amount of sandblasting grit we receive will be proportional to the size of the job it is to be used on.

The sandblasting grit will then be fed into the asphalt plant in the same manner as the other sand and rock products. The rate of feed will be approximately 5% of the total feed.

The finished asphalt and concrete will be trucked to the job site and placed no differently than any other asphalt concrete.

PHONE: 916-241-2932 / FAX: 916-243-0787
P.O. BOX 994138, REDDING, CA 96099-4138

Any sandblasting grit at the site in Orland not consumed this fall will be covered and stored on a concrete pad at the site until it is incorporated into asphalt concrete next spring.

The first project in which we hope to use a portion of the sandblasting grit is a Caltrans project paving the Northbound lane of Interstate 5 from post mile 20 to post mile 28.8 in Glenn County. This project is beginning this next week and we hope to incorporate the sand into the asphalt as soon as we obtain a use permit, thus time is of the essence.

If I can provide any further information, please contact me at your convenience.

Very truly yours,

Laura Baker

Laura K. Baker

Battelle
. . . Putting Technology To Work

505 King Avenue
Columbus, Ohio 43201-2693
Telephone (614) 424-6424
Facsimile (614) 424-5263

October 6, 1993

Glenn County Department of Health
Glenn County, CA

Attention: Mr. Gregory Lindholm

Dear Mr. Lindholm:

This letter briefly responds to your request for clarification of several points concerning the proposed recycling of hazardous sandblasting grit from Hunters Point Annex (HPA) into asphalt concrete by Orland Asphalt of Orland, California, owned by Jaxon Enterprises. Project details, including a summary of all of the previous activities conducted and results obtained on this project are summarized in two documents that were submitted under separate cover:

a) Work Plan for Recycling Sandblasting Grit into Asphalt Concrete, Hunters Point Annex, (dated July, 1993).

b) Hunters Point Annex Grit Asphalt Test Strip Characterization Report: Results of Samples Collected June, 1993, (dated August 9, 1993).

1) This project is funded by the U.S. Navy, and Battelle Memorial Institute, an independent, non-profit research and development laboratory in Columbus, Ohio, is the prime contractor. Mr Jeff Heath of the Naval Civil Engineering Laboratory (NCEL) is the Project Officer and I am the Program Manager. Both the U.S. Navy as well as Battelle Memorial Institute will be providing coordination and oversight through project completion, and will ensure that all project-related activities are coordinated in compliance with the work plan and relevant regulatory requirements. Subsequent to the successful completion of this project, the NCEL intends to document the project and transfer the recycling technology to other Naval installations. Battelle is an independent party in this project, holds no interests in asphalt plants or proprietary rights over the technology, and therefore does not benefit from the outcome of the project.

2) Prior to shipment to Orland, the grit will be milled and screened on-site at HPA. A risk screening analysis pertaining to fugitive dust emissions during this operation was conducted in conjunction with the California Air Resources Board (contact, Ms. Renee Campouya), which resulted in a "not significant" [risk] rating. The Bay Area Air Quality Management District

(contact, Ms. Catherine Fortney) issued a letter indicating that an exemption or permit would not be necessary for this project, provided that activities were conducted in compliance with the work plan.

3) The grit will be transported from HPA to Orland Asphalt in covered trucks by Pacific Rim, Inc. of San Leandro, California. The truck drivers will be provided documentation of the chemical composition of the grit, directions to Orland Asphalt, and a list of agencies to contact in case of an accident.

4) Prior to grit shipment, Orland Asphalt will build a concrete pad on plant premises upon which to store the grit.

5) Orland Asphalt will store the grit in compliance with containment requirements in California Health and Safety Code (HSC) Sections 25143.2 and 25143.9. In addition to being stored at all times on an impervious concrete pad, the grit pile will be covered with tarpaulins to prevent infiltration of water and dust dispersion. No discharge to either the air, surface, or groundwater is expected or likely to occur.

6) Orland Asphalt is in the process of securing the approval of CALTRANS prior to recycling the sandblasting grit into asphalt concrete. CALTRANS will perform mix design tests to verify that the asphalt concrete containing grit meets CALTRANS criteria.

7) During asphalt production, Battelle will be collecting periodic asphalt concrete samples for: (a) analysis of metals content to determine compliance with Cal EPA "Use Constituting Disposal" (UCD) policy; and (b) for performing physical tests on the asphalt to determine long-term durability.

8) Orland Asphalt will ensure compliance with OSHA worker safety requirements when the grit is in use at the hot plant. Workers will be briefed on the hazards of the sandblasting grit and on procedures to use to prevent exposure.

9) Since its inception several year ago, this project has been conducted in close coordination with Cal EPA, Department of Toxic Substances Control in Sacramento. Ms. Jessie Schnell, who is involved in hazardous materials recycling, has been our point-of-contact. Ms. Schnell has: (a) verified that the HPA sandblasting grit complies with the requirements for a recycling exemption under both the UCD policy and the HSC; (b) indicated that the involvement of her office or the cognizant regional office of Cal EPA is not necessary; and (c) informed us that the generator may self-certify to demonstrate compliance with the leachable metals criteria set forth in the UCD policy. A draft letter from Ms. Schnell documenting these statements has been requested.

I hope this clarifies your questions. Please feel free to contact me at (614) 424-5442 or fax (614) 424-3667 if you have any concerns, questions, or suggestions.

Sincerely,

Jeffrey L. Means, Ph.D.
Department Manager
Environmental Technology Department

JLM:gm

cc: Jeff Heath, NCEL, fax (805) 984-2947
Jack Baker, Jaxon Enterprises, fax (916) 243-0787

Battelle
. . . Putting Technology To Work

505 King Avenue
Columbus, Ohio 43201-2693
Telephone (614) 424-6424
Facsimile (614) 424-5263

October 6, 1993

Cal EPA
Department of Toxic Substances Control
400 P Street
P.O. Box 806
Sacramento, CA 95812-0806

Attention: Ms. Jessie Schnell

Dear Ms. Schnell:

This letter is a follow-up to our several recent conversations regarding the U.S. Navy's planned research and development project to recycle spent hazardous sandblasting grit from Hunters Point Annex (HPA), California, into asphalt concrete. The following documentation pertaining to the project has been provided under separate cover:

a) Work Plan for Recycling Sandblasting Grit into Asphalt Concrete, Hunters Point Annex, (dated July, 1993).

b) Hunters Point Annex Grit Asphalt Test Strip Characterization Report: Results of Samples Collected June, 1993, (dated August 9, 1993).

The proposed asphalt plant for participating in this study is Orland Asphalt, of Orland, California, in Glenn County.

It has been our mutual interpretation that the subject material meets all of the criteria for a statutory exemption for recyclable materials in Sections 25143.2 (b) through (e) of the California Health and Safety Code (HSC) and therefore is legally recyclable into asphalt concrete for the following reasons:

1) The HPA sandblasting grit is not a RCRA waste and does not fail the TTLC.

2) The grit will be mixed with other asphalt ingredients.

3) Grit-containing asphalt test strips laid in a previous phase of this project meet the STLC criteria defined in Cal EPA's "Use in a Manner Constituting Disposal" policy dated October, 1989, i.e., STLC's are met after subtracting out the effect of dilution from binder ingredients (see attached Tables 1-4).

4) Tests were conducted during a pilot-scale asphalt recycling demonstration on this material that showed that the recyclable material adds no hazard to either the recycling operation or the final product.

5) The final product will be used in commercial paving projects.

Could you please indicate your concurrence that the subject HPA sandblasting grit meets the criteria for a statutory exemption for recyclable materials in the HSC and that the generator may self-certify to this exemption in writing to me at fax (614) 424-3667 at your earliest convenience. Thank you very much for your consideration, and if you have any comments, questions, or suggestions, please contact me at (614) 424-5442.

Sincerely,

JLMeans

Jeffrey L. Means. Ph.D.
Department Manager
Environmental Technology Department

JLM:gm

cc: Jeff Heath, NCEL, fax (805) 984-2947
Jack Baker, Jaxon Enterprises, fax (916) 243-0787
Gregory Lindholm, Glenn County Department of Health, fax (916) 934-6592

Table 1: Calculations for Pb in Asphalt Test Strips Containing Untreated Grit

| | |
|---|---|
| Mean Total Pb Content of Grit: | 204 mg/kg |
| Mean WET Pb Content of Grit: | 19 mg/L |
| A) WET Pb Content of Asphalt Test Strips (Average of 4 values for field cores from 1991 and 1993 sampling) | 0.13 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb content of Asphalt Test Strips (A-B) | 0.06 mg/L |
| D) Dilution Factor-Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 1.2 mg/L |
| F) STLC for Pb | 5.0 mg/L |

Table 2: Calculations for Cu in Asphalt Test Strips Containing Untreated Grit

| | |
|---|---|
| Mean Total Cu Content of Grit: | 1,832 mg/kg |
| Mean WET Cu Content of Grit: | 144 mg/L |
| A) WET Pb Content of Asphalt Test Strips (Average of 4 values for field cores from 1991 and 1993 sampling) | 0.85 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Pb content of Asphalt Test Strips (A-B) | 0.75 mg/L |
| D) Dilution Factor-Untreated Test Strips | 20 |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 15 mg/L |
| F) STLC for Cu | 25 mg/L |

Table 3: Calculations for Pb in Asphalt Test Strips Containing Sulfide-Treated Grit

| | |
|---|---|
| Mean Total Pb Content of Grit: | 160 mg/kg |
| Mean WET Pb Content of Grit: | 11.1 mg/L |
| A) WET Pb Content of Asphalt Test Strips (Average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.07 mg/L |
| C) Background-Corrected WET Pb content of Asphalt Test Strips (A-B) | 0.03 mg/L |
| D) Dilution Factor-Sulfide Treated Test Strips | 22 mg/L |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 0.66 mg/L |
| F) STLC for Pb | 5.0 mg/L |

Table 4: Calculations for Cu in Asphalt Test Strips Containing Sulfide-Treated Grit

| | |
|---|---|
| Mean Total Cu Content of Grit: | 1,300 mg/kg |
| Mean WET Cu Content of Grit: | 55.5 mg/L |
| A) WET Pb Content of Asphalt Test Strips (Average of 4 values for field cores from 1991 and 1993 sampling) | 0.63 mg/L |
| B) WET Pb Content of Control Asphalt Test Strips (average of 4 values for field cores from 1991 and 1993 sampling) | 0.10 mg/L |
| C) Background-Corrected WET Pb content of Asphalt Test Strips (A-B) | 0.53 mg/L |
| D) Dilution Factor-Sulfide Treated Test Strips | 22 mg/L |
| E) Dilution-Corrected WET Pb Content of Asphalt Test Strips (C*D) | 11.7 mg/L |
| F) STLC for Pb | 25 mg/L |

Glenn County Planning Department
125 South Murdock Street
Willows, California 95988

# NEGATIVE DECLARATION

CASE: **CONDITIONAL USE PERMIT #93-10**

APPLICANT: **Jaxon Enterprises**
P.O. Box 9944248
Redding, CA 96099-4248

PROJECT:

Conditional Use Permit to allow incorporation of 3200 tons of recycled sand blasting grit from Hunter's Point Naval Base into the production of Asphalt Concrete to be used by Caltrans.

APN: 44-160-018, 44-230-002,005.

LOCATION: South of County Road "7", west of Interstate 5, north of Orland.

ZONE: "AE-20", Exclusive Agricultural, twenty acre minimum parcel size.

LAND USE ELEMENT OF THE GENERAL PLAN:

"Agriculture General", twenty acre minimum parcel size.

FLOOD ZONE:

According to Federal Flood Insurance Rate Map 0165B, this area is in Flood Zone "C", not subject to flooding, and Flood Zone "A", subject to flooding.

FINDINGS FOR NEGATIVE DECLARATION:

1. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will be compatible with the existing Conditional Use Permit for gravel extraction and processing.

2. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will be a benefit to the County by using recycling and bringing income to the County.

3. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans will not have any potential adverse effect on wildlife resources because this use will be combined with an existing Conditional Use Permit.

4. That the proposed Conditional Use Permit to allow the use of sand blasting grit in asphalt for Caltrans may have an adverse impact on air quality, water quality, and traffic but these impacts will be mitigated by the following stated mitigation measures and no other significant adverse impacts are expected.

MITIGATING MEASURES:

(numbers refer to Condition of Approval Numbers):

6. That the applicant shall provide the Glenn County Planning Department with proof of fiscal responsibility whether by establishing a net worth of more than 250 million dollars ($250,000,000.00) or by filing a Certificate of Insurance in the amount of one million dollars ($1,000,000.00). Said insurance coverage shall be maintained for the term of the permit. The Certificate of Insurance shall be filed with the Glenn County Planning Department within thirty (30) days from the date of approval of this Conditional Use Permit.

10. That the applicant shall secure a permit from any other County or State agencies that are necessary. Copies of said permits shall be filed with the Glenn County Planning Department.

11. That the permit holder shall comply with the terms and conditions of this permit unless more restrictive conditions have been included in other required permits in which case the more restrictive shall apply.

12. That the permit holder shall conduct all project related operations in a manner that safeguards employees and the public and shall comply with the State Health and Safety Code.

15. That the applicant shall inform the County Planning Department where the asphalt material containing the sand blasting grit shall be used prior to any storage or use of sand blasting grit at the site.

20. That the storage area for the sand blasting grit shall fully contain the material and shall be completely covered.

21. That sand blasting grit shall be stored out of the flood plain.

22. That if the sand blasting grit incorporation into asphalt operation ceases for ninety (90) consecutive days, all unused sand blasting grit shall be removed within the next ninety (90) days.

25. That the applicant shall provide the Glenn County Planning Department, Glenn County Air Pollution Control District, and the Glenn County Health Department with written documentation of each load of sand blasting grit received at the site and written documentation of the location of each shipment of asphalt containing the sand blasting grit on Wednesday of each week for the preceding week. This documentation shall contain the following information:

a) Date, time, quantity of recyclable material received;

b) Date, time quantity destination, exact location, copy of invoice document, and name of supervisor of project when recycled asphalt is shipped.

The proposed project cannot, or will not, have a significant impact on the environment. Negative Declaration Status is therefore granted for this project and an Environmental Impact Report is thereby not necessary.

| | | |
|---|---|---|
| Review by Planning Director | October 14, 1993<br>Date | ____________<br>Planning Director |
| Review by Planning Commission | October 27, 1993<br>Date | ____________<br>Chairman |

**CONDITIONS OF APPROVAL**
**COUNTY OF GLENN**
**CONDITIONAL USE PERMIT #93-10**
**Jaxon Enterprises Use of Sand Blasting Grit.**

Pursuant to the approval of the Glenn County Planning Commission on October 27, 1993, there is hereby granted to **Jaxon Enterprises** Conditional Use Permit #93-10 to allow incorporation of 3200 tons of recycled sand blasting grit from Hunter's Point Naval Base into the production of Asphalt Concrete; at APN: 44-160-018, 44-230-002, 005, County Road "7", North of Orland, subject to the following terms and conditions:

1. That the area in operation shall be confined to those areas as delineated in Exhibit "A" as filed with the Planning Department.

2. That this permit shall be void October 27, 1994. All sand blasting grit and all asphalt containing sand blasting grit shall be removed from the site prior to October 27, 1994.

3. That the applicant and the landowners shall file a signed copy of the Conditional Use Permit Conditions of Approval with the Planning Department prior to November 8, 1993, or this Conditional Use Permit shall be void.

4. That if upon approval of this Conditional Use Permit any health or safety hazard arises due to the operation allowed by this Conditional Use Permit; the Planning Commission shall hold a Public Hearing to hear comments and consider whether Conditions of Approval need to be revised, added, or revoked.

5. That this Conditional Use Permit authorizes only one operator at a time at this site. Any successor or assignee to **Jaxon Enterprises** shall send a letter to the Planning Department prior to assumption or transfer of operations stating that they have read and understand this Conditional Use Permit and agree to each and every condition thereof.

6. That the applicant shall provide the Glenn County Planning Department with proof of fiscal responsibility whether by establishing a net worth of more than 250 million dollars ($250,000,000.00) or by filing a Certificate of Insurance in the amount of one million dollars ($1,000,000.00). Said insurance coverage shall be maintained for the term of the permit. The Certificate of Insurance shall be filed with the Glenn County Planning Department within thirty (30) days from the date of approval of this Conditional Use Permit.

7. That the applicant shall pay a nonrefundable Mitigation Monitoring Fee of Two Thousand Dollars ($2,000.00) within ten (10) working days from the date of approval of this Conditional Use Permit. Upon notification by the Planning Department the applicant shall deposit additional money, within ten days of such notification, to maintain a balance not less than One Thousand Five Hundred Dollars ($1500.00). These funds shall also be used to reimburse the Glenn County Air Pollution Control District and the Glenn County Health Department for their expenses in monitoring this project.

8. That minor changes in these conditions may be made by the Technical Advisory Committee provided that the changes are requested in writing and no adverse environmental impacts will result.

9. That the applicant agrees as a condition of issuance and use of this entitlement to defend at its sole expense any action brought against the County within 180 days after the issuance of this entitlement because of or resulting from any proceeding preliminary to or the actual issuance of this entitlement, or, in the alternative, to relinquish such entitlement. Applicant will reimburse the County for any Court costs and attorney's fees which the County may be required by a Court to pay as a result of such action. County may at its sole discretion, participate in the defense of any such action, but such participation shall not relieve applicant of its obligations under this condition.

10. That the applicant shall secure a permit from any other County or State agencies that are necessary. Copies of said permits shall be filed with the Glenn County Planning Department by the applicant.

11. That the permit holder shall comply with the terms and conditions of this permit unless more restrictive conditions have been included in other required permits in which case the more restrictive shall apply.

12. That the permit holder shall conduct all project related operations in a manner that safeguards employees and the public and shall comply with the State Health and Safety Code.

13. That the applicant shall allow unannounced periodic site inspection by County Officials and State Agency representatives in order to evaluate continuing compliance with the Conditional Use Permit and the terms and conditions prescribed herein.

14. The site shall be constructed to prevent seepage and runoff. The applicant shall submit a detailed site plan to be approved by the Technical Advisory Committee prior to construction of the concrete pad for the sand blasting grit.

15. That the applicant shall inform the County Planning Department where the asphalt material containing the sand blasting grit shall be used prior to any storage or use of sand blasting grit at the site.

16. That the applicant shall inform the County Planning Department twenty-four (24) hours prior to the start of this project.

17. That the applicant shall remove all solid waste from the sand blasting grit to an approved site.

18. That the Glenn County Landfill shall not accept any solid waste from the sand blasting grit unless or until the State of California shall hold the County harmless.

19. That the applicant shall not deposit any waste material on the site.

20. That the storage area for the sand blasting grit shall fully contain the material and shall be completely covered to prevent runoff and to provide protection from wind gusts.

21. That sand blasting grit shall be stored out of the flood plain.

22. That if the sand blasting grit incorporation into asphalt operation ceases for ninety (90) consecutive days, all unused sand blasting grit shall be removed within the next ninety (90) days.

23. That the plant shall not exceed 20% opacity while processing recycled asphalt.

24. That the applicant shall notify (GCAPCD) 24 hours prior to each batch process of recycled asphalt.

25. That the permittee shall provide the Glenn County Planning Department, Glenn County Air Pollution Control District, and the Glenn County Health Department with written documentation of each load of sand blasting grit received at the site and written documentation of the location of each shipment of asphalt containing the sand blasting grit on Wednesday of each week for the preceding week. This documentation shall contain the following information:

a) Date, time, quantity of recyclable material received;

b) Date, time quantity destination, exact location, copy of invoice document, and name of supervisor of project when recycled asphalt is shipped.

26. That the permittee shall submit a Risk Assessment for evaluation by the Glenn County Air Pollution Control District (GCAPCD) prior to bringing any sand blasting grit to the site. The risk assessment criteria will be based on process data made available by permittee. The specific information required includes:

a) dilution factor of grit
b) quantity of recycled asphalt to be processed per hour, per day
c) number of hours of production per day, per week
d) distance, in meters of residences adjacent to storage area

27. That the permittee shall prepare an operations plan for the procedures at the Jaxon Enterprises Orland site for review and approval by the Technical Advisory Committee prior to the start of this project.

28. That the permittee shall not ship the material into Glenn County until assurances by Caltrans or any other public agencies are secured and that the public agency will use the material.

DATE OF ISSUANCE: JOHN BENOIT, PLANNING DIRECTOR

BY: ______________

ACCEPTANCE:
I have read and understand the foregoing Use Permit and agree to each and every term and condition thereof.

Date: ______________ ______________ Permittee

Date: ______________ ______________ Landowner

## APPENDIX E-3

## SIXTY-DAY EXTENSION OF CONDITIONAL USE PERMIT

GLENN COUNTY
PLANNING DEPARTMENT

125 South Murdock
WILLOWS, CALIFORNIA 95988
(916) 934-6540

DIVERSIFIED FARMING
"Where Water Is King"

JOHN BENOIT
Planning Director

October 3, 1994

Ms. Laura Baker
Jaxon Enterprises
P.O. Box 994248
Redding, CA 96099-4248

Dear Ms. Baker:

RE: Conditional Use Permit # 93-10 Use of Sandblasting Grit

Since you are proposing to change your application for amendment of Conditional Use Permit # 93-10 this will require additional review by various public agencies. In the meantime I will extend Conditional Use Permit # 93-10 for sixty days to December 26, 1994 as allowed by Section 19.12.070 of the Glenn County Code which states the following:

***19.12.070 Expiration***
*An approved conditional use permit shall become null and void if not exercised within one (1) year from the date of final approval of the permit. An approved conditional use permit may be extended by the Planning Director for an additional sixty (60) calendar days provided that the applicant/owner submits a written request for extension to the Planning Director at least twenty-one (21) calendar days prior to the expiration date. Only one (1) extension shall be allowed for each permit. Any person aggrieved by the decision of the Planning Director may appeal as provided in Chapter 19.20.*

We will look forward to receiving your revised amendment application as soon as possible.

Yours truly,
John Benoit
John Benoit,
Planning Director

# APPENDIX E-4

# ONE-YEAR EXTENSION OF CONDITIONAL USE PERMIT

DIVERSIFIED FARMING
"Where Water Is King"

JOHN BENOIT
*Secretary to the Planning Commission*

# GLENN COUNTY
# PLANNING COMMISSION

125 South Murdock
WILLOWS, CALIFORNIA 95988
(916) 934-6540 • (916) 865-1204

RECEIVED
JAN 05 1995

~~December 21, 1994~~
1-3-95

Jaxon Enterprises
P.O. Box 994248
Redding, CA 96099-4248

Dear Ms. Baker:

RE: Amendment of Conditional Use Permit #93-10

On December 21, 1994, the Glenn County Planning Commission took the following action on your proposal:

__XX__ Conditionally Approved (Conditions attached)

______ Disapproved

You may appeal the action of the Planning Commission by filing an appeal in writing with the Glenn County Board of Supervisors, 526 W. Sycamore Street, Willows, CA 95988, within 10 days of the approval date (a filing fee will be required). The basis of the appeal shall be described in detail in the letter.

Enclosed are two (2) copies of the Conditions of Approval. Please sign one copy and return within ten (10) days of the date of approval to the Glenn County Planning Department, 125 South Murdock Avenue, Willows, CA 95988.

Yours truly,

Peggy White

Peggy White
Associate Planner

cc: Glenn County Public Works Director
Glenn County Health Department: Sanitarian
Glenn County Air Pollution Control Officer

**CONDITIONS OF APPROVAL**
**COUNTY OF GLENN**
**CONDITIONAL USE PERMIT #93-10**
**Jaxon Enterprises Use of Sand Blasting Grit.**

Pursuant to the approval of the Glenn County Planning Commission on December 21, 1994, there is hereby granted to **Jaxon Enterprises** Conditional Use Permit #93-10 to allow incorporation of 4800 tons of recycled sand blasting grit from Hunter's Point Naval Base into the production of Asphalt Concrete at 7% maximum concentration; at APN: 44-160-018, 44-230-002, 005, County Road "7", North of Orland, subject to the following terms and conditions:

1. That the area in operation shall be confined to those areas as delineated in Exhibit "A" as filed with the Planning Department.

2. That this permit shall be void December 21, 1995. All sand blasting grit and all asphalt containing sand blasting grit shall be removed from the site prior to December 21, 1995.

3. That the permittee and the landowners shall file a signed copy of the Conditional Use Permit Conditions of Approval with the Planning Department prior to January 2, 1995, or this Conditional Use Permit shall be void.

4. That if upon approval of this Conditional Use Permit any health or safety hazard arises due to the operation allowed by this Conditional Use Permit; the Planning Commission shall hold a Public Hearing to hear comments and consider whether Conditions of Approval need to be revised, added, or revoked.

5. That this Conditional Use Permit authorizes only one operator at a time at this site. Any successor or assignee to **Jaxon Enterprises** shall send a letter to the Planning Department prior to assumption or transfer of operations stating that they have read and understand this Conditional Use Permit and agree to each and every condition thereof.

6. That the permittee shall provide the Glenn County Planning Department with proof of fiscal responsibility whether by establishing a net worth of more than 250 million dollars ($250,000,000.00) or by filing a Certificate of Insurance in the amount of one million dollars ($1,000,000.00). Said insurance coverage shall be maintained for the term of the permit. The Certificate of Insurance shall be filed with the Glenn County Planning Department within thirty (30) days from the date of approval of this Conditional Use Permit.

7. That the permittee shall pay a nonrefundable Mitigation Monitoring Fee of Two Thousand Dollars ($2,000.00) within ten (10) working days from the date of approval of this Conditional Use Permit. Upon notification by the Planning Department the permittee shall deposit additional money, within ten days of such notification, to maintain a balance not less than One Thousand Five Hundred Dollars ($1500.00). These funds shall also be used to reimburse the Glenn County Air Pollution Control District and the Glenn County Health Department for their expenses in monitoring this project.

8. That minor changes in these conditions may be made by the Technical Advisory Committee provided that the changes are requested in writing and no adverse environmental impacts will result.

9. That the permittee agrees as a condition of issuance and use of this entitlement to defend at its sole expense any action brought against the County within 180 days after the issuance of this entitlement because of or resulting from any proceeding preliminary to or the actual issuance of this entitlement, or, in the alternative, to relinquish such entitlement. Permittee will reimburse the County for any Court costs and attorney's fees which the County may be required by a Court to pay as a result of such action. County may at its sole discretion, participate in the defense of any such action, but such participation shall not relieve permittee of its obligations under this condition.

10. That the permittee shall secure a permit from any other County or State agencies that are necessary. Copies of said permits shall be filed with the Glenn County Planning Department by the permittee.

11. That the permit holder shall comply with the terms and conditions of this permit unless more restrictive conditions have been included in other required permits in which case the more restrictive shall apply.

12. That the permit holder shall conduct all project related operations in a manner that safeguards employees and the public and shall comply with the State Health and Safety Code.

13. That the permittee shall allow unannounced periodic site inspection by County Officials and State Agency representatives in order to evaluate continuing compliance with the Conditional Use Permit and the terms and conditions prescribed herein.

14. The storage area shall be constructed to prevent seepage and runoff. The permittee shall submit a detailed site plan to be approved by the Technical Advisory Committee prior to construction of the concrete pad for the sand blasting grit.

15. That the permittee shall inform the County Planning Department where the asphalt material containing the sand blasting grit shall be used prior to any storage or use of sand blasting grit at the site.

16. That the permittee shall inform the County Planning Department twenty-four (24) hours prior to the start of this project.

17. That the permittee shall remove all solid waste from the sand blasting grit to an approved site.

18. That the Glenn County Landfill shall not accept any solid waste from the sand blasting grit unless or until the State of California shall hold the County harmless.

19. That the permittee shall not deposit any waste material on the site.

20. That the storage area for the sand blasting grit shall fully contain the material and shall be completely covered to prevent runoff and to provide protection from wind gusts.

21. That sand blasting grit shall be stored out of the flood plain.

22. That if the sand blasting grit incorporation into asphalt operation ceases business for ninety (90) consecutive days, all unused sand blasting grit shall be removed within the next ninety (90) days.

23. That the plant shall not exceed 20% opacity while processing recycled asphalt.

24. That the permittee shall notify (GCAPCD) 24 hours prior to each batch process of recycled asphalt.

25. That the permittee shall provide the Glenn County Planning Department, Glenn County Air Pollution Control District, and the Glenn County Health Department with written documentation of each load of sand blasting grit received at the site and written documentation of the location of each shipment of asphalt containing the sand blasting grit on Wednesday of each week for the preceding week. This documentation shall contain the following information:

a) Date, time, quantity of recyclable material received;

b) Date, time quantity destination, exact location, copy of invoice document, and name of supervisor of project when recycled asphalt is shipped.

26. That the permittee shall submit a Risk Assessment for evaluation by the Glenn County Air Pollution Control District (GCAPCD) prior to bringing any sand blasting grit to the site. The risk assessment criteria will be based on process data made available by permittee. The specific information required includes:

    a) dilution factor of grit
    b) quantity of recycled asphalt to be processed per hour, per day
    c) number of hours of production per day, per week
    d) distance, in meters of residences adjacent to storage area

27. That the permittee shall prepare an operations plan for the procedures at the Jaxon Enterprises Orland site for review and approval by the Technical Advisory Committee prior to the start of this project.

28. That the permittee shall not ship the material into Glenn County until assurances by Caltrans or any other public agencies are secured and that the public agency will use the material.

29. That upon completion of the project a final report shall be submitted to the Technical Advisory Committee for approval.

DATE OF ISSUANCE: JOHN BENOIT, PLANNING DIRECTOR

BY: ______________

ACCEPTANCE:
I have read and understand the foregoing Use Permit and agree to each and every term and condition thereof.

Date: ________________ ____________________
Permittee

Date: ________________ ____________________
Landowner

# APPENDIX F

# CALIFORNIA DEPARTMENT OF TRANSPORTATION
# SECTION 39
# ASPHALT CONCRETE

# SECTION 39

# ASPHALT CONCRETE

## 39-1 GENERAL

**39-1.01 Description.**—This work shall consist of furnishing and mixing aggregate and asphalt binder at a central mixing plant, spreading and compacting the mixture, and furnishing and placing pavement reinforcing fabric, all as specified in these specifications and the special provisions.

Asphalt concrete is designated as Type A, Type B, Type C, or Open Graded.

Asphalt concrete base is designated as Type A or Type B.

The type of asphalt concrete or asphalt concrete base will be shown on the plans or specified in the special provisions.

Asphalt concrete and asphalt concrete base shall be produced in a batch mixing plant, a continuous pugmill mixing plant or a drier-drum mixing plant. Proportioning shall be either by hot-feed control or cold-feed control.

## 39-2 MATERIALS

**39-2.01 Asphalts.**—Asphalt binder to be mixed with aggregate shall be liquid asphalt or paving asphalt as designated by the contract item. When there is no separate contract item for asphalt binder, paving asphalt shall be used unless liquid asphalt is specified in the special provisions.

Liquid asphalt to be mixed with aggregate shall conform to the provisions in Section 93, "Liquid Asphalts," and shall be of the grade designated by the contract item.

Paving asphalt to be mixed with aggregate shall be a steam-refined asphalt conforming to the provisions in Section 92, "Asphalts," and shall be of the grade designated in the special provisions or as determined by the Engineer.

Liquid asphalt for prime coat shall conform to the provisions in Section 93, "Liquid Asphalts," and shall be of the grade designated by the contract item or specified in the special provisions.

Asphaltic emulsion for paint binder shall conform to the provisions in Section 94, "Asphaltic Emulsions," for the rapid-setting or slow-setting type and grade selected by the Engineer.

Paving asphalt to be used as a binder for pavement reinforcing fabric shall be a steam-refined asphalt conforming to the provisions in Section 92, "Asphalts," and shall be Grade AR-4000, unless otherwise ordered by the Engineer.

**39-2.02 Aggregate.**—All aggregates shall be clean and free from decomposed materials, organic material and other deleterious substances.

Coarse aggregate is material retained on the No. 4 sieve; fine aggregate is material passing the No. 4 sieve; and supplemental fine aggregate is added fine material passing the No. 30 sieve, including dust from dust collectors.

Unless otherwise specified in the special provisions, the aggregate grading of the various types of asphalt concrete shall conform to the following:

| Type | Grading |
|---|---|
| A | ¾ inch maximum, coarse |
| B | ¾ inch maximum, medium |
| C | ¾ inch maximum, medium |
| Open Graded | ⅜ inch maximum |

The combined aggregate, prior to the addition of asphalt binder, shall conform to the requirements of this section. Conformance with the grading requirements will be determined by California Test 202, modified by California Test 105 when there is a difference in specific gravity of 0.2 or more between the coarse and fine portions of the aggregate or between blends of different aggregates. If the results do not fall within the limits shown under "Operating Range," but are within limits for "Contract Compliance," placement of asphalt concrete may be continued for the remainder of that day. However, another day's work may not be started until tests, or other information, indicate to the satisfaction of the Engineer that the next material to be used in the work will comply with the requirements for "Operating Range."

If the results of grading tests are not within the limits for "Contract Compliance," the asphalt concrete represented by these tests shall be removed unless the Engineer determines that said asphalt concrete is structurally adequate and may remain in place. If this asphalt concrete is left in place, the Contractor shall pay to the State $1.75 per ton of aggregate for such asphalt concrete. The Department may deduct this amount from any moneys due, or that may become due, the Contractor under the contract. No single grading test shall represent more than 500 tons of aggregate or one day's paving whichever is smaller.

In the tables below, the symbol "X" is the gradation which the Contractor proposes to furnish for the specific sieve. The proposed gradation shall meet the gradation shown in the table under "Limits of Proposed Gradation." Changes from one mix design to another shall not be made during the progress of the work unless permitted by the Engineer. However, changes in proportions to conform to the approved mix design shall not be considered changes in mix design.

### AGGREGATE GRADING REQUIREMENTS

**Types A, B and C Asphalt Concrete**
**Percentage Passing**

**¾" Maximum, Coarse**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| 1" | | 100 | 100 |
| ¾" | | 90–100 | 87–100 |
| ⅜" | | 60–75 | 55–80 |
| No. 4 | 45–50 | X±5 | X±8 |
| No. 8 | 32–36 | X±5 | X±8 |
| No. 30 | 15–18 | X±5 | X±8 |
| No. 200 | | 3–7 | 0–10 |



**¾" Maximum, Medium**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| 1" | | 100 | 100 |
| ¾" | | 95–100 | 90–100 |
| ⅜" | | 65–80 | 60–85 |
| No. 4 | 49–54 | X±5 | X±8 |
| No. 8 | 36–40 | X±5 | X±8 |
| No. 30 | 18–21 | X±5 | X±8 |
| No. 200 | | 3–8 | 0–11 |

**½" Maximum, Coarse**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ¾" | | 100 | 100 |
| ½" | | 95–100 | 89–100 |
| ⅜" | | 75–90 | 70–95 |
| No. 4 | 55–61 | X±5 | X±8 |
| No. 8 | 40–45 | X±5 | X±8 |
| No. 30 | 20–25 | X±5 | X±8 |
| No. 200 | | 3–7 | 0–10 |

**½" Maximum, Medium**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ¾" | | 100 | 100 |
| ½" | | 95–100 | 89–100 |
| ⅜" | | 80–95 | 75–100 |
| No. 4 | 59–66 | X±5 | X±8 |
| No. 8 | 43–49 | X±5 | X±8 |
| No. 30 | 22–27 | X±5 | X±8 |
| No. 200 | | 3–8 | 0–11 |

**⅜" Maximum**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ½" | | 100 | 100 |
| ⅜" | | 95–100 | 95–100 |
| No. 4 | 73–77 | X±6 | X±10 |
| No. 8 | 58–63 | X±6 | X±10 |
| No. 30 | 29–34 | X±6 | X±10 |
| No. 200 | | 3–10 | 0–14 |

**No. 4 Maximum**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ⅜" | | 100 | 100 |
| No. 4 | | 95–100 | 95–100 |
| No. 8 | 72–77 | X±6 | X±10 |
| No. 30 | 37–43 | X±[illegible] | X±11 |
| No. 200 | | 3–12 | 0–16 |

**Open Graded Asphalt Concrete**
**Percentage Passing**

**½" Maximum**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ¾" | | 100 | 100 |
| ½" | | 95–100 | 92–100 |
| ⅜" | 78–89 | X±4 | X±7 |
| No. 4 | 28–37 | X±4 | X±7 |
| No. 8 | 7–18 | X±4 | X±5 |
| No. 16 | | 0–10 | 0–13 |
| No. 200 | | 0–3 | 0–4 |

**⅜" Maximum**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| ½" | | 100 | 100 |
| ⅜" | | 90–100 | 88–100 |
| No. 4 | 29–36 | X±4 | X±7 |
| No. 8 | 7–18 | X±4 | X±5 |
| No. 16 | | 0–10 | 0–12 |
| No. 200 | | 0–3 | 0–4 |

**Types A and B Asphalt Concrete Base**
**Percentage Passing**

| Sieve Sizes | Limits of Proposed Gradation | Operating Range | Contract Compliance |
|---|---|---|---|
| 1½" | | 100 | 100 |
| 1" | | 95–100 | 92–100 |
| ¾" | | 80–100 | 77–100 |
| ⅜" | 55–60 | X±5 | X±8 |
| No. 4 | 40–45 | X±5 | X±8 |
| No. 30 | 14–19 | X±5 | X±8 |
| No. 200 | | 2–7 | 0–10 |

The combined aggregate shall conform to the following quality requirements prior to the addition of the asphalt:

| Tests | California Test | Asphalt Concrete Type A | Asphalt Concrete Type B | Asphalt Concrete Type C | Open Graded Asphalt Concrete | Asphalt Concrete Base Type A | Asphalt Concrete Base Type B |
|---|---|---|---|---|---|---|---|
| Percentage of Crushed Particles | 205 | | | | | | |
| Coarse Aggregate (min) | | 90% | 25% | — | 90% | 90% | 25% |
| Fine Aggregate (Passing No. 4, Retained on No. 8) (Min) | | 70% | 20% | — | 90% | 70% | 20% |
| Los Angeles Rattler | 211 | | | | | | |
| Loss at 100 Rev. (Max.) | | 10% | — | — | 10% | 10% | — |
| Loss at 500 Rev. (Max) | | 45% | 50% | — | 40% | 45% | 50% |



| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sand Equivalent | 217 | | | | | | |
| Individual Test Results (Min) | | 47 | 42 | 32 | — | 47 | 42 |
| Moving Average (Min) | | 50 | 45 | 35 | — | 50 | 45 |
| Film Stripping (Max)[1] | 302 | — | — | — | 25% | — | — |
| $K_c$ Factor (Max) | 303 | 1.7 | 1.7 | — | — | 1.7 | 1.7 |
| $K_f$ Factor (Max) | 303 | 1.7 | 1.7 | — | — | 1.7 | 1.7 |

[1]After mixing with asphalt binder

The asphalt concrete mixture, composed of the aggregate proposed for use and the optimum amount of asphalt as determined by California Test 367, shall conform to the following quality requirements:

| Tests | California Test | Asphalt Concrete Type A | Asphalt Concrete Type B | Asphalt Concrete Type C | Open Graded Asphalt Concrete | Asphalt Concrete Base Type A | Asphalt Concrete Base Type B |
|---|---|---|---|---|---|---|---|
| Swell (Max.) | 305 | 0.030" | 0.030" | 0.030" | — | 0.030" | 0.030" |
| Moisture Vapor Susceptibility (Min.) | 307 | 30 | 25 | 20 | — | 30 | 25 |
| Stabilometer Value (Min.) | 366 | 37 | 35 | 30 | — | 37 | 35 |
| Stabilometer Value (Min.) (⅜" or No. 4 Max. A.C.) | 366 | 30 | 30 | — | — | — | — |

**39-2.03 Pavement Reinforcing Fabric.**—Pavement reinforcing fabric shall conform to the provisions in Section 88, "Engineering Fabrics."

## 39-3 STORING, PROPORTIONING AND MIXING MATERIALS

**39-3.01 Storage.**—Aggregate shall be stored so that separately sized aggregates will not be intermingled, and asphalt binder shall be stored so that different grades of asphalt will not be intermingled. Any aggregate which has been intermingled with another size of aggregate shall be removed and replaced with aggregate of specified grading. As used in this specification, "cold storage" is the storing of aggregates prior to their having been processed in a drier, and "hot storage" is the storing of aggregates after their having been processed in a drier. "Hot-feed control" and "cold-feed control" indicate the location of measuring devices or controls.

When the Contractor adds supplemental fine aggregate, each such supplemental fine aggregate used shall be stored separately and kept thoroughly dry.

The measurement and storage requirements of this Section 39-3, shall not apply to the dust collected in skimmers and expansion chambers (knock-out boxes) or to the dust collected in centrifugal (cyclone) collectors. Dust from these collectors may be returned to the aggregate without being measured or stored separately, provided the dust is returned uniformly at a point in advance of the sampling device in batch-mix and continuous pugmill mixing plants or between the sampling device and the drier-drum mixer in drier-drum mixing plants.

Aggregate and asphalt binder shall also be stored in conformance with the following:

**39-3.01A Cold Storage.**—When aggregate contains material of which at least 20 percent will pass the No. 8 sieve, the material shall be fed from storage by means of a mechanical feeder.

Before being fed to the drier, aggregate shall be separated into sizes and stored as follows:

**39-3.01A (1) Cold Storage for Plants Utilizing Hot-Feed Control.**—Aggregate for Type A or Type B asphalt concrete of the ¾ inch and ½ inch maximum sizes shall be separated into 2 or more sizes and stored separately.

Aggregate for Type C asphalt concrete, aggregate for Type A or Type B asphalt concrete of the ⅜ inch maximum size and the No. 4 maximum size, aggregate for Open Graded asphalt concrete, and aggregate for asphalt concrete base need not be separated into sizes and stored separately.

**39-3.01A (2) Cold Storage for Plants Utilizing Cold-Feed Control.**—When the Contractor elects to use a plant equipped with cold-feed control, aggregate for asphalt concrete of the ¾ inch and ½ inch maximum sizes and aggregate for asphalt concrete base shall be separated into 3 or more sizes. Aggregate for asphalt concrete of the ⅜ inch maximum size and aggregate for Open Graded asphalt concrete shall be separated into 2 or more sizes. Aggregate for asphalt concrete of No. 4 maximum size need not be separated.

After the aggregate is separated, each size shall be stored separately.

**39-3.01B Hot Storage.**—After being dried, aggregate for Type C asphalt concrete need not be separated into sizes. Aggregate for Type A, Type B, and Open Graded asphalt concrete and asphalt concrete base, after being dried, shall be stored in accordance with the following:

**39-3.01B (1) Hot Storage for Plants Utilizing Hot-Feed Control.**—Aggregates for asphalt concrete of ¾ inch and ½ inch maximum sizes and aggregate for asphalt concrete base shall be separated into 3 or more sizes. Aggregate for asphalt concrete of ⅜ inch maximum size and aggregate for Open Graded asphalt concrete shall be separated into 2 or more sizes. Aggregate for asphalt concrete of No. 4 maximum size need not be separated.

After the aggregate is separated, each size shall be stored in a separate bin and shall be recombined in conformance with the provisions in Section 39-3.03, "Proportioning," to conform to the gradings specified in Section 39-2, "Materials."

Storage bins shall be provided with chutes to prevent overflow into adjacent bins.

**39-3.01B (2) Hot Storage for Plants Utilizing Cold-Feed Control and Batch Mixing.**—The aggregate shall not be separated into sizes after being dried, and one or more surge bins shall be provided between the drier and the weigh hopper. The weigh hopper shall be charged from only one bin which shall feed into the center of the hopper. The amount of aggregate stored in any surge bin at any one time shall not exceed the weight of one batch. When the Contractor adds supplemental fine aggregate, each supplemental fine aggregate used shall be stored separately and kept thoroughly dry.

**39-3.01C Asphalt Binder Storage.**—Asphalt to be used as a binder for asphalt concrete shall be stored in tanks accurately calibrated to 100-



gallon intervals and maintained to this accuracy. They shall be made accessible for measuring the volume of asphalt at any time.

The Contractor shall provide a suitable sampling device in asphalt feed lines connecting plant storage tanks to the asphalt weighing system or spray bar. The sampling device shall consist of a ½ inch or ¾ inch valve constructed in such a manner that a one-quart sample may be withdrawn slowly at any time during plant operations. The valve shall be maintained in good condition, and if it fails to function properly, it shall be replaced. The sampling device shall be readily accessible and in an area free of dangerous obstructions. A drainage receptacle shall be provided for flushing the device prior to sampling.

The discharge end of the asphalt binder circulating pipe shall be maintained below the surface of the asphalt binder in the storage tank to prevent discharging hot asphalt binder into open air.

A temperature-indicating device shall be installed in the asphalt line at a suitable location. The device shall indicate temperature of the asphalt and shall be accurate to 10° F.

**39-3.02 Drying.**—Aggregate shall be fed directly to a drier-drum mixer or to a drier at a uniform rate.

Except for mixtures produced in a drier-drum mixer, drying shall continue for a sufficient time and at a sufficiently high temperature that, at the time of spreading, the moisture content of the completed mixture shall not exceed one percent. At the time of spreading, mixtures produced in a drier-drum mixer shall not contain more than 3 percent moisture. Moisture content will be determined by California Test 310, 311, or 370.

The drier or drier-drum mixer shall be provided with a device which indicates the temperature of the material leaving the drier or the drier-drum mixer. The temperature-indicating device shall be accurate to the nearest 10° F. and shall be installed in such a manner that changes of 10° F. in temperature of the material will be shown within one minute.

Except for Type C asphalt concrete, driers or drier-drum mixers shall be provided with dust collectors. Dust so collected shall be returned to the aggregate in accordance with the provisions in Section 39-3.03, "Proportioning," or disposed of in accordance with the provisions in Section 7-1.13, "Disposal of Material Outside the Highway Right of Way."

**39-3.03 Proportioning.**— Before producing asphalt concrete, the Contractor shall submit in writing to the Engineer the gradation of the aggregate for each mix which he proposes to furnish. If the aggregate i separated into 2 or more sizes, the proposed gradation shall consist o gradations for individual sizes, and the proposed proportions of individua sizes, combined mathematically to indicate one proposed gradation. Such gradation shall meet the applicable grading requirements shown in Section 39-2.02, "Aggregate," and shall show the percentage passing each o the specified sieve sizes.

At least 7 working days prior to their intended use, the Contractor shal furnish samples of aggregates, in the quantity requested by the Engineer from the source he proposes to use for the project. Said samples shall have been processed in a manner representative of that for the material to b used in the work. The bitumen ratio (pounds of asphalt per 100 pound of dry aggregate including supplemental fine aggregate, if used) will b designated by the Engineer.

Should the Contractor change his source of supply, he shall furnish nev samples and proposed proportions, as determined by the Engineer to b necessary, at least 7 working days before their intended use. A change which affects not more than 15 percent of the total aggregate in the mix will not be considered a change in source. Where asphalt concrete is to be produced from established sources and if acceptable to the Engineer, the Contractor may advise the Engineer in writing that the source, gradings and proportions of those aggregates proposed to be furnished are the same as those approved for, and used on, another prior or concurrent project. The project shall be identified by contract number.

**39-3.03A Proportioning for Batch Mixing.**—When the Contractor elects to use batch mixing equipment, each aggregate storage bin shall be equipped with a suitable, safe sampling device which will provide a sample of the aggregate discharged into the weigh hopper or volumetric proportioning bin.

When supplemental fine aggregate is used, it shall be proportioned by weight as provided in Subsection (1), "Weight Proportioning" of Section 39-3.03A (1a), "Manual Proportioning," or by volume as provided in Section 39-3.03B, "Proportioning for Continuous Mixing." A suitable, safe sampling device shall be installed in each feed line or surge tank preceding the weigh hopper. The delivery point of samples shall be safe and convenient.

**39-3.03A (1) Proportioning for Batch Mixing with Hot-Feed Control.**—Aggregate and asphalt shall be proportioned by weight or by volume as follows:

**39-3.03A (1a) Manual Proportioning.**—An automatic plant shall not be operated manually unless the automatic circuitry is disconnected to the extent that it cannot be activated by the mere operation of a switch, circuit breaker, or some other similar routine procedure.

When manual proportioning is used in the production of asphalt concrete, proportioning shall conform to the following:

(1) Weight Proportioning.—The zero tolerance for aggregate scales shall be 0.5-percent of the total batch weight of the aggregate. The zero tolerance for separate scales for weighing supplemental fine aggregate or asphalt binder shall be 0.05-percent of the total batch weight of the aggregate.

The indicated weight of material drawn from storage for any draft of material shall not vary from the preselected scale setting by more than the following percentages of the total batch weight of the aggregate:

(a) Aggregate shall be within one percent, except that when supplemental fine aggregate is used and is weighed cumulatively with the aggregate, the draft of aggregate drawn immediately before the supplemental fine aggregate shall be within 0.5-percent.

(b) Supplemental fine aggregate shall be within 0.5-percent.

(c) Asphalt binder shall be within 0.1-percent.

The asphalt binder shall be measured by a tank scale.

(2) Volumetric Proportioning.—Each size of aggregate shall be proportioned in a separate bin that is adjustable in size. Each



bin shall have a gate or other device so designed that the bin shall be completely filled and struck off in measuring the volume of aggregate to be used in the mix. Means shall be provided for calibrating the weight of material in each measuring bin at any time. The plant shall be operated in such a manner that the material in each aggregate bin is within 2 percent of the weight preselected for the type of mixture being produced.

Asphalt binder shall be proportioned by a meter or an adjustable calibrated tank. When meters are used, the asphalt lines leading to asphalt meters shall be full-circulating or shall be regulated so that, during plant stoppages, the temperature of the asphalt does not change more than 15° F. from the temperature maintained while the plant is in full operation. Asphalt binder shall be proportioned to within 2 percent of the weight preselected for the mixture being produced.

**39-3.03A (1b) Automatic Proportioning.**—When automatic batch mixing is required by the special provisions or when the Contractor elects to use an automatic batching system, the proportioning devices shall be automatic to the extent that the only manual operation required for proportioning all materials for one batch shall be a single operation of a switch or starter.

(1) Weight Proportioning.—Automatic proportioning devices shall be of a type in which materials discharged from the several bins are controlled by gates or by mechanical conveyors. The batching devices shall be so interlocked that no new batch may be started until all weigh hoppers are empty, the scales are at zero, and the discharge gates are closed. The means of withdrawal from the bins and of discharge from the weigh box shall be interlocked so that not more than one bin can discharge onto any given scale at one time, and that the weigh box cannot be tripped until the required quantity from each of the bins has been deposited therein. In addition, automatic proportioning devices shall be interlocked so that the weighing cycle will be interrupted whenever the amount of material drawn from any storage varies from the preselected amount by more than the tolerances specified in Section 39-3.03A (1a), "Manual Proportioning." Whenever the weighing cycle is interrupted, that specific batch shall not be used in the work unless it can be manually adjusted to meet the specified tolerances based on the total weight of the batch. When partial batches are batched automatically, the interlock tolerances, except the zero tolerance, shall apply to the total weight of aggregate in the partial batch.

Automatic proportioning devices shall be operated so that all weight increments required for a batch are preset on the controls at the same time. Controls shall be designed so that these settings may be changed without delay, and the order of discharge from the several bins can be changed as directed by the Engineer.

Automatic proportioning controls shall be equipped with means for inspection of the interlock tolerance settings, and instructions for doing so shall be immediately available at the point of operation.

In order to check the accuracy of proportioning during plant operation, the Contractor shall provide means to check-weigh various proportions on separate scales.

(2) Volumetric Proportioning.—Asphalt binder shall be proportioned by an adjustable calibrated tank.

Automatic volumetric proportioning devices shall be of a type which will not allow the bins to discharge into the mixer unless the mixer is empty and the mixer discharge gate is closed and will not operate unless the aggregate bins and asphalt binder tank are full.

The automatic proportioning device shall operate in such a manner that the material in each aggregate bin and the asphalt binder tank is within 2 percent of the preselected weights.

The Contractor shall provide means by which the accuracy of the proportioning may be checked during plant operation by weight checks of the material drawn from any given bin or tank.

A means shall be provided to prevent proportioning when there is any material remaining in the volumetric bins from the previous batch.

**39-3.03A (2) Proportioning for Batch Mixing with Cold-Feed Control.**—Aggregate and asphalt binder shall be proportioned by weight as specified in Section 39-3.03A (1), "Proportioning for Batch Mixing with Hot-Feed Control."

**39-3.03B Proportioning for Continuous Mixing.**—When continuous pugmill mixing or drier-drum mixing is used, asphalt binder shall be introduced into the mixer through a meter conforming to the requirements of Section 9-1.01, "Measurement of Quantities." The system shall be capable of varying the rate of delivery of binder. During any day's run, the temperature of asphalt binder shall not vary more than 50° F. The meter and lines shall be heated and insulated. The storage for binder shall be equipped with a device for automatic plant cut-off when the level of binder is lowered sufficiently to expose the pump suction line.

When supplemental fine aggregate is used, it shall be proportioned by weight or volume by a method that uniformly feeds the material within 10 percent of the required amount. Supplemental fine aggregate shall be discharged from the proportioning device directly into the mixer.

**39-3.03B (1) Proportioning for Continuous Pugmill Mixing with Hot-Feed Control.**—The correct proportions of each aggregate size introduced into the mixer shall be drawn from the storage bins by a continuous mechanical or electrical feeder, which will supply the correct amount of aggregate in proportion to the asphalt binder, and be arranged so that the proportion of each aggregate size can be adjusted separately. The fine aggregate bins and supplemental fine aggregate bins, if used, shall be equipped with vibrating units or other equipment which will prevent any hang-up of the material while the plant is operating. Before the quantity of material in any one bin reaches the strike-off capacity of the feed gate, the device shall automatically close down the plant instantly. The plant shall not be operated unless this automatic system is in good working condition.

Aggregate feeders that are driven mechanically shall be connected directly to the drive on the asphalt binder pump. The drive shaft on the feeder shall be equipped with a revolution counter reading to 1/10 of a revolution and of sufficient capacity to register the total



number of revolutions in a day's run.

Aggregate feeders that are driven electrically shall be actuated from the same circuit that serves the motor driving the asphalt binder pump. A frequency meter shall be connected to the circuit to the binder pump motor if electric power is obtained from a non-commercial source. The meter shall have a range from 57 Hz to 63 Hz, minimum, and shall be graduated in one-Hz increments, or less.

A voltage regulating transformer shall be installed in the circuit t vibratory-type aggregate feeders. The transformer shall maintain th voltage to the motors for the feeders to within one percent of thei nameplate voltage. A voltmeter shall be connected to the secondar of the voltage regulating transformer. The meter shall have a rang of from −10 percent to +10 percent of the motor nameplate voltag and shall be graduated in increments of one percent of the nameplat voltage, or less.

Power to plants equipped with electrically actuated aggregat feeders shall have a frequency of 60 ±1 Hz.

All continuous pugmill mixing plants, except when used for th production of Type C asphalt concrete, shall be equipped with hopper of at least 20 cubic feet in capacity which is divided into many compartments as there are sizes of aggregate being propo tioned, including supplemental fine aggregate if used. The hoppe shall be placed on a scale frame in such a manner that the discharg from each aggregate feeder may be diverted into separate compar ments in the hopper when the feeders are in full operation. Th device provided for diverting the discharge from each aggrega feeder shall be such that a sample of material from each feeder ma be collected and retained in the hopper without stopping the feeder The full weight of the loaded hopper shall be indicated on a scale not to exceed 5,000-pound capacity with 5-pound graduations. Eac compartment of the hopper shall be equipped with a gate so that eac size may be withdrawn separately on a conveyor below the hopp in order that the total weight of each size of aggregate may be dete mined and representative samples may be obtained. The material withdrawn may be wasted or returned to the drier.

Alternative methods of sampling which will provide representati samples of each size of aggregate, will be permitted. The samples sh be taken while the plant is in full operation and shall be such that t plant production rate can be determined therefrom. Any meth which does not consistently provide such representative samples sh be discontinued and the method specified in this Section 39-3.03B ( shall be used thereafter.

**39-3.03B (2) Proportioning for Continuous Pugmill Mixing Drier-Drum Mixing with Cold-Feed Control.**—When cold-feed co trol is used with continuous pugmill mixing or drier-drum mixing, t asphalt feeder, each of the aggregate feeders, the supplemental fi aggregate feeder, if used, and the combined aggregate feeder, sh be equipped with devices by which the rate of feed can be dete mined while the plant is in full operation.

The combined aggregate shall be weighed using a belt scale. T belt scale shall be of such accuracy that, when the plant is operati between 30 percent and 100 percent of belt capacity, the avera difference between the indicated weight of material delivered a the actual weight delivered will not exceed one percent of the actual weight for three 2-minute runs. For any of the 3 individual 2-minute runs, the indicated weight of material delivered shall not vary from the actual weight delivered by more than 2 percent of the actual weight. The actual weight of material delivered shall be determined by a vehicle platform scale, conforming to the requirements of Section 9-1.01, "Measurement of Quantities," that has been sealed just prior to checking the belt scale. The plant shall be equipped so that this accuracy check can be made prior to the first operation for a project and at any other time as directed by the Engineer.

The belt scale for the combined aggregate, the proportioning devices for supplemental fine aggregate, if used, and the asphalt proportioning meter shall be interlocked so that the rates of feed of the aggregates and asphalt will be adjusted automatically to maintain the bitumen ratio (pounds of asphalt per 100 pounds of dry aggregate including supplemental fine aggregate, if used) designated by the Engineer. The plant shall not be operated unless this automatic system is operating and in good working condition.

Asphalt meters and aggregate belt scales used for proportioning aggregates and asphalt shall be equipped with rate-of-flow indicators to show the rates of delivery of asphalt and aggregate, and resettable totalizers so that the total amounts of asphalt and aggregate introduced into the mixture can be determined.

The bin or bins containing the fine aggregate and supplemental fine aggregate, if used, shall be equipped with a vibrating unit or other equipment which will prevent any hang-up of material while the plant is operating. Before the quantity of material in any one bin reaches the strike-off capacity of the feed gate, a device shall automatically close down the plant.

The Contractor shall determine the moisture content of the aggregate at least once during each 2 hours of production and shall adjust the moisture control equipment accordingly.

For continuous pugmill mixing plants an aggregate sampling device which will provide a 60- to 80-pound sample of the combined aggregate while the plant is in full operation shall be provided in advance of the point where the aggregate enters the mixer, but after the aggregate is dried.

[redacted]

When supplemental fine aggregate is used, a suitable, safe sampling device shall be installed in each feed line or surge tank preceding the proportioning device for the supplemental fine aggregate.

39-3.04 Mixing.—Aggregate, supplemental fine aggregate, and asphalt binder shall be mixed in a batch mixer, continuous pugmill mixer or drier-drum mixer. The asphalt content of the asphalt mixture will be determined by extraction tests in accordance with California Test 310 or California Test 362. The bitumen ratio (pounds of asphalt per 100 pounds of dry aggregate including supplemental fine aggregate if used) shall not vary by more than 0.5-pound of asphalt above or 0.5-pound of asphalt below the amount designated by the Engineer. Compliance with this requirement will be determined by testing samples taken from the mat





behind the paver before rolling.

The charge in a batch mixer, or the rate of feed to a continuous mixer shall not exceed that which will permit complete mixing of all of th material. Dead areas in the mixer, in which the material does not mov or is not sufficiently agitated, shall be corrected by a reduction in th volume of material or by other adjustments.

~~Paving asphalt used as a binder shall be at a temperature of not less tha 250° F. or more than 375°~~ F. when added to the aggregate.

When paving asphalt is used as a binder, the temperature of the aggre gate before adding the binder, except for open-graded mixes, shall be nc more than 325° F. ~~The temperature of the aggregate for open-grade mixtures shall be not more than 275° F.~~

Liquid asphalt used as binder shall be added to the aggregate at temperature conforming to the range of temperatures provided in Sectio 93-1.03, "Mixing and Applying," for distributor application of the grade o liquid asphalt being used.

When liquid asphalt is used as a binder, the temperature of the aggr gate at the time of adding the binder shall not be in excess of the applic ble mixing temperature provided for pugmill mixing in said Sectio 93-1.03.

39-3.04A Batch Mixing.—When asphalt concrete is produced b batch mixing, the mixer shall be equipped with a sufficient number o paddles of a type and arrangement to produce a properly mixed batc

The binder shall be introduced uniformly into the mixer along th center of the mixer parallel to the mixer shafts, or by pressure sprayin When a pan is used, it shall be equipped with movable vanes in ord that the flow of binder may be directed across the width of the pan, desired. The vanes shall be equipped with a means for quick adjustmen and a positive lock to prevent shifting.

The mixer platform shall be of ample size to provide safe and conve ient access to the mixer and other equipment. The mixer housing ar weighbox housing shall be provided with gates of ample size to perm ready sampling of the discharge of aggregate from each of the plant bi and from each feed line or surge tank of supplemental fine aggregat if used. The Contractor shall provide a sampling device capable delivering a representative sample of sufficient size to permit the r quired tests.

The mixer shall be equipped with a timing device which will indica by a definite audible or visual signal the expiration of the mixing perio The device shall measure the time of mixing within ± 2 seconds.

The time of mixing a batch shall begin on the charging stroke of th weighhopper dumping mechanism and shall end when discharge started. Mixing shall continue until a homogeneous mixture of uniform distributed and properly coated aggregates of unchanging appearan is produced. The time of mixing shall be not less than 30 seconds.

When automatic proportioning or automatic batch mixing is requir by the special provisions or when the Contractor elects to use an aut matic batching system, an interval timer shall control the time of mi ing. The interval timer shall be interlocked so that the mixer cannot b discharged until all of the materials have been mixed for the full tin specified.

39-3.04B Continuous Pugmill Mixing.—When asphalt concrete produced by continuous pugmill mixing, the mixer shall be equipp with paddles of a type and arrangement to provide sufficient mixing action and movement to the mixture to produce properly mixed asphalt concrete. Said mixer shall be provided with an adjustable barrier or dam at the discharge end to control mixing time. The mixer platform shall be of ample size to provide safe and convenient access to the mixer and other equipment.

Mixing shall continue until a homogeneous mixture of uniformly distributed and properly coated aggregates of unchanging appearance is produced.

On plants utilizing cold-feed control, the combined aggregate shall be fed directly from the drier to the mixer at a uniform and controlled rate.

**39-3.04C Drier-Drum Mixing.**—When asphalt concrete is produced in a drier-drum mixer, mixing shall continue for a sufficient time and at a sufficiently high temperature that, at discharge from the mixer, the sizes of aggregates are uniformly distributed through the completed mixture and all particles are thoroughly and uniformly coated with asphalt binder.

Temperature of the completed mixture shall not exceed 325° F. at discharge from the mixer.

The drier-drum mixer shall be discharged into a storage silo with a capacity of not less than that specified in Section 39-3.05, "Asphalt Concrete Storage." The Contractor shall provide a means of diverting the flow of asphalt concrete away from the silo, when starting and stopping the plant production, to prevent incompletely mixed portions of the mixture from entering the silo.

The burner used for heating the aggregate in the drier-drum shall achieve complete combustion of the fuel.

**39-3.05 Asphalt Concrete Storage.**—When asphalt concrete is stored, it shall be stored only in silos. Asphalt concrete shall not be stockpiled. The minimum quantity of asphalt concrete in storage during mixing shall be 20 tons except for the period immediately following a shutdown of the plant of 2 hours or more. A means shall be provided to indicate that storage in each silo is being maintained as required.

The storage silo shall be equipped to prevent segregation of the completed mixture as it is discharged into the silo.

Open Graded asphalt concrete stored in excess of 2 hours, and any other asphalt concrete stored in excess of 18 hours, shall not be used in the work.

Asphalt concrete with hardened lumps in the mixture shall not be used. Any storage facility which contained the material with the hardened lumps shall not be used for further storage until the cause of the lumps is corrected.

**39-3.06 Asphalt Plants.**—Any plants, including commercial plants, that produce asphalt concrete that is subject to these specifications shall conform to the provisions in Section 7-1.01F, "Air Pollution Control," and shall be equipped with a wet-tube dust washer or equal and other devices which will reduce the dust emission to the degree that adjacent property is not damaged. The washer and other equipment shall function efficiently at all times when the plant is in operation.

### 39-4. SUBGRADE, PRIME COAT, PAINT BINDER, AND PAVEMENT REINFORCING FABRIC

**39-4.01 Subgrade.**—Immediately prior to applying prime coat or paint binder, or immediately prior to placing the asphalt concrete or asphalt



concrete base when a prime coat or paint binder is not required, the subgrade to receive asphalt concrete or asphalt concrete base shall conform to the compaction requirement and elevation tolerances specified for the material involved and shall be free of loose or extraneous material. If the asphalt concrete is to be placed on an existing base or pavement which was not constructed as part of the contract, the Contractor shall clean the surface by sweeping, flushing or other means to remove all loose particles of paving, all dirt and all other extraneous material immediately before applying the prime coat or paint binder.

**39-4.02 Prime Coat and Paint Binder.**—A prime coat of liquid asphalt shall be applied to the areas to be surfaced when there is a contract item for such work or when such work is required by the special provisions.

Prime coat shall be applied only to those areas designated by the Engineer.

Prime coat shall be applied at the approximate total rate of 0.25-gallon per square yard of surface covered. The exact rate and number of applications will be determined by the Engineer.

Prime coat shall be applied at a temperature conforming to the range of temperatures provided in Section 93-1.03, "Mixing and Applying," for distributor application of the grade of liquid asphalt being used.

A paint binder of asphaltic emulsion shall be furnished and applied in accordance with the provisions in Section 94, "Asphaltic Emulsions," and shall be applied to all vertical surfaces of existing pavement, curbs, gutters, and construction joints in the surfacing against which additional material is to be placed, to a pavement to be surfaced, and to other surfaces designated by the Engineer.

Paint binder shall be applied in one application at a rate of from 0.02- to 0.10-gallon per square yard of surface covered. The exact rate of application will be determined by the Engineer.

Before placing a layer of Open Graded asphalt concrete on any other type of asphalt concrete or on an existing bituminous pavement, paint binder shall be applied in one application at a rate of from 0.05-to 0.10-gallon per square yard of surface covered. The exact rate of application will be determined by the Engineer.

At the Contractor's option, paving asphalt may be used for paint binder instead of asphaltic emulsion. If paving asphalt is used, the grade to be used and the rate of application will be determined by the Engineer. The paving asphalt shall be applied at a temperature of not less than 285° F. nor more than 350° F.

Prime coat or paint binder shall be applied only so far in advance of placing the surfacing as may be permitted by the Engineer.

Immediately in advance of placing asphalt concrete or asphalt concrete base, additional prime coat or paint binder shall be applied as directed by the Engineer to areas where the prime coat or paint binder has been damaged, and loose or extraneous material shall be removed, and no additional compensation will be allowed therefor.

**39-4.03 Pavement Reinforcing Fabric.**—Pavement reinforcing fabric shall be placed on existing pavement to be surfaced or between layers of asphalt concrete when such work is shown on the plans, or specified in the special provisions, or ordered by the Engineer.

Before placing the pavement reinforcing fabric, a binder of paving asphalt shall be applied to the surface to receive the pavement reinforcing fabric at an approximate rate of 0.25-gallon per square yard of surface covered. The exact rate will be determined by the Engineer. The binder shall be applied to a width equal to the width of the fabric mat plus 3 inches on each side.

Before applying binder, large cracks, spalls and chuckholes in existing pavement shall be repaired as directed by the Engineer, and such repair work will be paid for as extra work as provided in Section 4-1.03D.

The fabric shall be stretched, aligned, and placed with no wrinkles that lap. The test for lapping shall be made by gathering together the fabric in a wrinkle. If the height of the doubled portion of extra fabric is ½ inch or more, the fabric shall be cut to remove the wrinkle, then lapped in the direction of paving. Lap in excess of 2 inches shall be removed.

Pavement reinforcing fabric shall not be placed in areas of conform tapers where the thickness of the overlying asphalt concrete is 0.08-foot or less.

If manual laydown methods are used, the fabric shall be unrolled, stretched, aligned, and placed in increments of approximately 30 feet.

Adjacent borders of the fabric shall be lapped 2 to 4 inches. The preceding roll shall lap 2 to 4 inches over the following roll in the direction of paving at ends of rolls or at any break. At fabric overlays, both the tack coat and the fabric shall overlap the previously placed fabric by the same amount.

Seating of the fabric with rolling equipment after placing will be permitted. Turning of the paving machine and other vehicles shall be gradual and kept to a minimum to avoid damage.

A small quantity of asphalt concrete, to be determined by the Engineer, may be spread over the fabric immediately in advance of placing asphalt concrete surfacing in order to prevent fabric from being picked up by construction equipment.

Public traffic shall not be allowed on the bare reinforcing fabric, except that public cross traffic shall be allowed to cross the fabric, under traffic control, after the Contractor has placed a small quantity of asphalt concrete over the fabric.

Care shall be taken to avoid tracking binder material onto the pavement reinforcing fabric or distorting the fabric during seating of the fabric with rolling equipment. If necessary, exposed binder material shall be covered lightly with sand.

## 39-5 SPREADING AND COMPACTING EQUIPMENT

**39-5.01 Spreading Equipment.**—Blading equipment shall consist of pneumatic-tired motor graders having a blade not less than 12 feet long and a wheel base not less than 17 feet long. The motor graders shall be free from appreciable lost motion in the blade control and shall have rigid frames.

Asphalt pavers shall be self-propelled mechanical spreading and finishing equipment, provided with a screed or strike-off assembly capable of distributing the material to not less than the full width of a traffic lane. Screed action shall include any cutting, crowding or other practical action which is effective on the mixture without tearing, shoving or gouging, and which produces a surface texture of uniform appearance. The screed shall be adjustable to the required section and thickness. The paver shall be provided with a full width roller or tamper or other suitable compacting devices. Pavers that leave ridges, indentations or other marks in the surface shall not be used unless the ridges, indentations or other marks are



eliminated by rolling or prevented by adjustment in operation.

The asphalt paver shall operate independently of the vehicle being unloaded or shall be capable of propelling the vehicle being unloaded in a satisfactory manner and, if necessary, the load of the haul vehicle shall be limited to that which will insure satisfactory spreading. While being unloaded the haul vehicle shall be in contact with the machine at all times, and the brakes on the haul vehicle shall not be depended upon to maintain contact between the vehicle and the machine.

~~The procedure whereby material is deposited in a windrow, then picked up and placed in the asphalt paver with loading equipment, will be permitted for all asphalt concrete except Open Graded, provided the asphalt paver is of such design that the material will fall into a hopper which has a movable bottom conveyor to feed the screed and the loading equipment is constructed so that substantially all of the material deposited on the roadbed is picked up and deposited in the paving machine.~~

No portion of the weight of hauling or loading equipment, other than the connection, shall be supported by the asphalt paver, and no vibrations or other motions of the loader, which could have a detrimental effect on the riding quality of the completed pavement, shall be transmitted to the paver.

**39-5.02 Compacting Equipment.**—For each asphalt paver, the Contractor shall furnish a minimum of one steel-tired roller weighing not less than 8 tons and, except for placing Open Graded asphalt concrete, one steel-tired roller weighing not less than 12 tons and one pneumatic-tired roller. Each roller shall have a separate operator. All rolling equipment shall be self-propelled and reversible. The minimum number, weight, and type of rollers required may be reduced or modified in accordance with the provisions of Section 39-6.03, "Compacting," for low rates of production or when alternative equipment is approved by the Engineer.

All rollers shall be equipped with pads and water systems which prevent sticking of asphalt mixtures to the pneumatic- or steel-tired wheels. A parting agent, which will not damage the asphalt mixture, as determined by the Engineer, may be used to aid in preventing the sticking of the mixture to the wheels.

Other equipment, approved by the Engineer in accordance with California Test 113, may be substituted for 3-wheel or tandem rollers when used as specified in Section 39-6.03, "Compacting."

Pneumatic-tired rollers shall be the oscillating type having a width of not less than 4 feet with pneumatic tires of equal size, diameter and having treads satisfactory to the Engineer. Wobble-wheel rollers will not be permitted. The tires shall be spaced so that the gaps between adjacent tires will be covered by the following tires, or shall be spaced so that any resulting uncovered gap will not exceed 1 ½ inches in width when the tires are inflated to 90 pounds per square inch and the operating weight is 2,000 pounds per tire.

When the pneumatic-tired roller furnished by the Contractor is constructed so that there is a resulting gap between tire tracks as permitted in the preceding paragraph, the complete coverages of asphalt concrete with the roller required in Section 39-6.03, "Compacting," shall be increased by one complete coverage for each ½ inch, or fraction thereof, of the maximum uncovered gap between any 2 tire tracks.

The tires shall be inflated to 90 pounds per square inch, or such lower pressure as designated by the Engineer, and maintained so that the air pressure will not vary more than 5 pounds per square inch from the designated pressure. Pneumatic-tired rollers shall be constructed so that the total weight of the roller can be varied to produce an operating weight per tire of not less than 2,000 pounds. The total operating weight of the roller shall be varied as directed by the Engineer.

Pneumatic-tired rollers will not be required when approved vibratory rollers are furnished and used as specified in Section 39-6.03, "Compacting."

## 39-6 SPREADING AND COMPACTING

39-6.01 **General Requirements.**—Unless lower temperatures are directed by the Engineer, all mixtures, except ~~Open Graded asphalt concrete, shall be spread, and the first coverage of initial or breakdown compaction shall be performed when the temperature of the mixture is not less than 250°~~ F., and all breakdown compaction shall be completed before the temperature of the mixture drops below 200° F. Open Graded asphalt concrete shall be spread at a temperature of not less than 200° F. and not more than 250° F., measured in the hopper of the paving machine.

Type A, Type B, or Type C asphalt concrete shall be placed only when the atmospheric temperature is above 50° F. Asphalt concrete base shall be placed only when the atmospheric temperature is above 40° F. ~~Open Graded asphalt concrete shall be placed only when the atmospheric temperature is above 70° F., and, where placement is to be on bridges or other structures, when the surface temperature of such structure is above 60° F.~~

Asphalt concrete and asphalt concrete base shall not be placed when the underlying layer or surface is frozen, or when, in the opinion of the Engineer, weather conditions will prevent the proper handling, finishing, or compaction of the mixtures.

Asphalt concrete and asphalt concrete base shall be spread and compacted in layers. The top layer of asphalt concrete shall not exceed 0.20-foot in compacted thickness. The next lower layer shall not exceed 0.25-foot in compacted thickness, and any lower layers shall not exceed 0.40-foot in compacted thickness. Each layer of asphalt concrete base shall not exceed 0.40-foot in compacted thickness. No layer shall be placed over a layer which exceeds 0.25-foot in compacted thickness until the temperature at mid depth, of the layer which exceeds 0.25-foot in compacted thickness, is not more than 160° F.

Asphalt concrete and asphalt concrete base to be placed on shoulders, and other areas off the traveled way having a width of 5 feet or more, shall be spread in the same manner as specified above. When the shoulders and other areas are less than 5 feet in width, the material may be deposited and spread in one or more layers by any mechanical means that will produce a uniform smoothness and texture. Unless otherwise shown on the plans, asphalt mixtures shall not be handled, spread or windrowed in a manner that will stain the finished surface of any pavement or other improvements.

The completed mixture shall be deposited on the roadbed at a uniform quantity per linear foot, as necessary to provide the required compacted thickness without resorting to spotting, picking-up or otherwise shifting the mixture.

Segregation shall be avoided, and the surfacing shall be free from pockets of co[illegible]r fi[illegible]terial[illegible]phalt concrete containing hardened lumps



shall not be used.

Longitudinal joints in the top layer shall correspond with the edges of proposed traffic lanes. Longitudinal joints in all other layers shall be offset not less than 0.5-foot alternately each side of the edges of traffic lanes. The Engineer may permit other patterns of placing longitudinal joints if he considers that such patterns will not adversely affect the quality of the finished product.

Unless otherwise provided herein or permitted by the Engineer, the top layer of asphalt concrete for shoulders, tapers, transitions, road connections, private drives, curve widenings, chain control lanes, turnouts, left turn pockets, and other such areas, shall not be spread before the top layer of asphalt concrete for the adjoining through lane has been spread and compacted. At locations where the number of lanes is changed, the top layer for the through lanes shall be paved first. When existing pavement is to be surfaced and the specified thickness of asphalt concrete to be spread and compacted on the existing pavement is 0.20-foot or less, shoulders or other adjoining areas may be spread simultaneously with the through lane provided the completed surfacing conforms to the requirements of these specifications. Tracks or wheels of spreading equipment shall not be operated on the top layer of asphalt concrete in any area until final compaction has been completed.

At locations shown on the plans, specified in the special provisions or as directed by the Engineer, the asphalt concrete shall be tapered or feathered to conform to existing surfacing or to other highway and non-highway facilities.

At locations where the asphalt concrete is to be placed over areas inaccessible to spreading and rolling equipment, the asphalt concrete shall be spread by any means to obtain the specified results and shall be compacted thoroughly to the required lines, grades and cross sections by means of pneumatic tampers, or by other methods that will produce the same degree of compaction as pneumatic tampers.

39-6.02 **Spreading.**—In advance of spreading asphalt concrete over an existing base, surfacing, pavement, or bridge deck, if ordered by the Engineer, asphalt concrete shall be spread to level irregularities, and to provide a smooth base in order that subsequent layers will be of uniform thickness. The asphalt concrete may be spread with any equipment conforming to the requirements in Section 39-5.01, "Spreading Equipment." No additional compensation will be allowed for spreading asphalt concrete as above specified, and full compensation for all work incidental to such operations will be considered as included in the contract price or prices paid for the asphalt concrete.

When directed by the Engineer, paint binder shall be applied to any layer in advance of spreading the next layer.

Before placing the top layer adjacent to cold transverse construction joints, such joints shall be trimmed to a vertical face and to a neat line. Transverse joints shall be tested with a 12-foot straightedge and shall be cut back as required to conform to the requirements specified in Section 39-6.03, "Compacting," for surface smoothness. Connections to existing surfacing shall be feathered to conform to the requirements for smoothness. Longitudinal joints shall be trimmed to a vertical face and to a neat line if the edges of the previously laid surfacing are, in the opinion of the Engineer, in such condition that the quality of the completed joint will be affected.

All layers, except as otherwise provided in Section 39-6.01, "General Requirements," and in this Section 39-6.02, shall be spread with an asphalt paver. Asphalt pavers shall be operated in such a manner as to insure continuous and uniform movement of the paver.

**39-6.03 Compacting.**—Compacting equipment shall conform to the provisions of Section 39-5.02, "Compacting Equipment."

A pass shall be one movement of a roller in either direction. A coverage shall be as many passes as are necessary to cover the entire width being paved. Overlap between passes during any coverage, made to insure compaction without displacement of material in accordance with good rolling practice, shall be considered to be part of the coverage being made and not part of a subsequent coverage. Each coverage shall be completed before subsequent coverages are started.

Rolling shall commence at the lower edge and shall progress toward the highest portion, except that when compacting layers which exceed 0.25-foot in compacted thickness, and if directed by the Engineer, rolling shall commence at the center and shall progress outwards.

Initial or breakdown compaction shall consist of 3 coverages of a layer of asphalt mixture and shall be performed with a 2-axle or 3-axle tandem or a 3-wheel roller weighing not less than 12 tons and having rolling wheels with a diameter of 40 inches or more. Where the thickness of the layer of asphalt mixture is less than 0.15-foot, fewer coverages than specified above may be ordered by the Engineer if necessary to prevent damage to the layer being compacted.

The initial or breakdown compaction shall be followed immediately by additional rolling consisting of 3 coverages with a pneumatic-tired roller. Coverages with a pneumatic-tired roller shall start when the temperature of the mixture is as high as practicable, preferably above 180° F., and shall be completed while the temperature of the mixture is at or above 150° F.

Excepting Open Graded asphalt concrete, each layer of asphalt concrete and asphalt concrete base shall be compacted additionally without delay by a final rolling consisting of not less than one coverage with a steel-tired roller weighing not less than 8 tons. Except as otherwise provided for low rates of production, a separate finish roller will be required. [redacted]

Rolling shall be performed so that cracking, shoving or displacement will be avoided.

Rolling, where 3-axle tandem rollers may be used as specified in this Section 39-6.03, shall be under the control of the Engineer, but in general, no 3-axle tandem roller shall be used in rolling over a crown or on warped sections when the center axle is in the locked position.

Provided it is demonstrated to the satisfaction of the Engineer that one roller can perform the work, the required minimum rolling equipment specified above may be reduced to one 2-axle tandem roller, weighing at least 8 tons, for each paver under any of the following conditions:

(1) When asphalt concrete is placed at a rate of 50 tons, or less, per hour at any location.

(2) When asphalt concrete is placed at a rate of 100 tons, or less, per hour and at the locations or under the conditions as follows:

(a) Placed on miscellaneous areas in accordance with the provisions in Section 39-7.01, "Miscellaneous Areas."



(b) When the width to be placed is less than 8 feet.

(c) When the total thickness to be placed is less than 0.1-foot.

(3) When the total amount of asphalt concrete included in the contract is 1,000 tons, or less.

When rolling equipment is reduced as provided in this Section 39-6.03, the rolling requirements may be reduced to at least 3 complete coverages with said tandem roller.

Alternative compacting equipment, approved by the Engineer in accordance with California Test 113, may be used for the initial or breakdown compaction if operated according to the procedures and under the conditions designated in the approval. Additional compaction with pneumatic-tired rollers will not be required when approved alternative equipment has been used for the initial compaction. A vibratory roller may be used as the finish roller provided that it meets the requirements for a finish roller and is operated with the vibratory unit turned off.

During rolling operations, and when ordered by the Engineer, the asphalt concrete shall be cooled by applying water. Applying water shall conform to the provisions in Section 17, "Watering." No layer shall be cooled with water unless so ordered or permitted by the Engineer.

The completed surfacing shall be thoroughly compacted, smooth, and free from ruts, humps, depressions, or irregularities. Any ridges, indentations or other objectionable marks left in the surface of the asphalt concrete by blading or other equipment shall be eliminated by rolling or other means. The use of any equipment that leaves ridges, indentations, or other objectionable marks in the asphalt concrete shall be discontinued, and acceptable equipment shall be furnished by the Contractor.

When a straightedge 12 feet long is laid on the finished surface and parallel with the center line, the surface shall not vary more than 0.01-foot from the lower edge of the straightedge. The transverse slope of the finished surface shall be uniform to a degree such that no depression greater than 0.02-foot are present when tested with a straightedge 12 feet long laid in a direction transverse to the center line and extending from edge to edge of a 12-foot traffic lane.

Pavement within 50 feet of a structure or approach slab shall conform to the smoothness tolerances specified in Section 51-1.17, "Finishing Bridge Decks."

## 39-7 MISCELLANEOUS

**39-7.01 Miscellaneous Areas.**—Surfacing of miscellaneous areas, such as median areas exclusive of inside shoulders, island areas, sidewalks, dikes, gutters, gutter flares, ditches, overside drains, aprons at the ends of drainage structures, and other areas outside the traveled way which are designated on the plans as miscellaneous areas to be paved with asphalt concrete, shall conform to these specifications.

The combined aggregate grading for asphalt concrete placed on miscellaneous areas shall conform to that specified for the asphalt concrete placed on the traveled way, unless otherwise directed by the Engineer. The amount of asphalt binder used in the asphalt concrete placed in dikes, gutters, gutter flares, overside drains and aprons at the ends of drainage structures, unless otherwise directed by the Engineer, shall be increased one percent by weight of the aggregate over the amount of asphalt binder used in the asphalt concrete placed on the traveled way.

The asphalt concrete placed in median areas exclusive of inside shoulders, island areas, sidewalks, dikes, gutters, gutter flares, ditches, overside drains, aprons at the ends of drainage structures and other areas outside the traveled way which are designated on the plans as miscellaneous areas to be paved with asphalt concrete may be spread in one layer. The material shall be compacted to the required lines, grades and cross section.

Dikes shall be shaped and compacted with an extrusion machine or other equipment capable of shaping and compacting the material to the required cross section.

**39-7.02 Seal Coat.**—Where shown on the plans or provided in the special provisions, a fog seal coat shall be applied to the surface of Types A, B, or C asphalt concrete in accordance with the provisions in Section 37, "Bituminous Seals."

### 39-8 MEASUREMENT AND PAYMENT

**39-8.01 Measurement.**—Asphalt concrete and asphalt concrete base will be measured by weight. The quantity to be paid for will be either the combined weight of the mixture or the weight of the separate items for the various types of aggregate and the type of asphalt binder, whichever is designated in the Engineer's Estimate.

The weight of the materials will be determined as provided in Section 9-1.01, "Measurement of Quantities."

Quantities of paving asphalt, liquid asphalt and asphaltic emulsion to be paid for as contract items of work will be determined in accordance with the methods provided in Sections 92, "Asphalts," 93, "Liquid Asphalts," or 94, "Asphaltic Emulsions," as the case may be.

The quantity of aggregate to be paid for as a contract item will be the difference between the weight of the completed mixture and the weight of the asphalt binder added thereto.

When recorded batch weights are printed automatically, these weights may be used for determining pay quantities providing the following requirements are complied with:

a. Total aggregate, filler material and collector dust weight per batch shall be printed. When filler material or collector dust is weighed cumulatively with the aggregate, the total batch weight of aggregate shall include such filler material or collector dust.

b. Total bitumen weight per batch shall be printed.

c. Zero-tolerance weight shall be printed prior to weighing the first batch and after weighing the last batch of each truckload.

d. Time, date, mix number, load number and truck identification shall be correlated with load slip.

e. A copy of the recorded batch weights shall be certified by a licensed weighmaster and submitted to the Engineer.

When there is a contract item to place asphalt concrete dikes by the linear foot, the quantity to be paid for will be the length in feet measured along the completed dike. When there is a contract item to place asphalt concrete (miscellaneous area), the quantity to be paid for will be the area in square yards of the asphalt concrete compacted in place. In addition to the quantiti[...]r placing asphalt concrete measured on a linear foot or square yard [...]sis, the aggregate and asphalt binder entering into the



mixture to be placed will also be measured for payment.

Pavement reinforcing fabric will be measured and paid for by the square yard for the actual pavement area covered.

**39-8.02 Payment.**—Asphalt concrete placed in the work, unless otherwise specified, will be paid for at the contract price per ton for aggregate (asphalt concrete), or Open Graded aggregate (asphalt concrete), or aggregate (asphalt concrete base), and at the contract price per ton for liquid asphalt (asphalt concrete), or paving asphalt (asphalt concrete); or aggregate and asphalt binder will be paid for at a single contract price per ton for asphalt concrete or asphalt concrete base.

When there is a contract item for place asphalt concrete dike by the linear foot, quantities of dikes will be paid for at the contract price o[...] prices for the aggregate and asphalt binder, or as a combined item and als[...] at the contract price per linear foot for place asphalt concrete dike. Ful[...] compensation for any necessary excavation and backfill involved in under[...]cutting cut slopes for constructing dikes will be considered as included i[...] the contract price paid per linear foot for place asphalt concrete dike an[...] no additional compensation will be allowed therefor.

Quantities of asphalt concrete placed in miscellaneous areas designate[...] in the special provisions or tabulated on the plans to be included in th[...] contract item of place asphalt concrete (miscellaneous area), will be pai[...] for at the contract price or prices for the aggregate and asphalt binder, o[...] as a combined item and also at the contract price per square yard for plac[...] asphalt concrete (miscellaneous area). Full compensation for preparin[...] the area to receive the asphalt concrete will be considered as included i[...] the contract price paid per square yard to place the asphalt concrete an[...] no additional compensation will be allowed therefor.

When there is no item for place asphalt concrete dike by the linear fo[...] or for place asphalt concrete (miscellaneous area) by the square yard an[...] such work is shown on the plans, full compensation therefor, including an[...] necessary excavation, backfill, and preparation of the area, shall be consi[...]ered as included in the contract price or prices paid for the aggregate an[...] asphalt binder, or the combined item of asphalt concrete.

Quantities of pavement reinforcing fabric placed and paving aspha[...] applied as a binder for the pavement reinforcing fabric will be paid for [...] the contract price per square yard for pavement reinforcing fabric an[...] per ton for paving asphalt (binder-pavement reinforcing fabric). Fu[...] compensation for furnishing and spreading sand to cover exposed bind[...] material, if necessary, shall be considered as included in the contract pri[...] paid per ton for paving asphalt (binder-pavement reinforcing fabric) ar[...] no separate payment will be made therefor.

Small quantities of asphalt concrete placed on pavement reinforci[...] fabric to prevent the fabric from being displaced by construction equi[...]ment or to allow traffic to cross over the fabric, shall be considered as pa[...] of the layer of asphalt concrete to be placed over the fabric and will [...] measured and paid for by the ton as aggregate (asphalt concrete) a[...] paving asphalt (asphalt concrete), or the combined item of asphalt co[...]crete.

When there is a contract item for liquid asphalt (prime coat), the qua[...]tity of prime coat will be paid for at the contract price per ton for t[...] designated grade of liquid asphalt (prime coat). When there is no contra[...] item for liquid asphalt (prime coat) and the special provisions require t[...] application of prime coat, full compensation for fur[...]ing and applyi[...]

prime coat shall be considered as included in the contract price or prices paid per ton for the aggregate and asphalt binder, or the combined item of asphalt concrete, and no separate payment will be made therefor.

When there is a contract item for asphaltic emulsion (paint binder), the quantity of asphaltic emulsion or paving asphalt used as paint binder will be paid for at the contract price per ton for asphaltic emulsion (paint binder). When there is no contract item for asphaltic emulsion (paint binder), full compensation for furnishing and applying paint binder shall be considered as included in the contract price or prices paid per ton for the aggregate and asphalt binder, or the combined item of asphalt concrete, and no separate payment will be made therefor.

Fog seal coat will be paid for as provided in Section 37-1, "Seal Coats."

No adjustment of compensation will be made for any increase or decrease in the quantities of paint binder or fog seal coat required, regardless of the reason for such increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities," shall not apply to the items of paint binder or fog seal coat.

The above contract prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing asphalt concrete and asphalt concrete base, complete in place, as shown on the plans and as specified in these specifications and the special provisions, and as directed by the Engineer.

## APPENDIX G

## STATE OF CALIFORNIA
## DEPARTMENT OF TOXIC SUBSTANCES CONTROL
## DEMONSTRATION VARIANCE FOR THE PILOT-SCALE TEST

STATE OF CALIFORNIA—ENVIRONMENTAL PROTECTION AGENCY

PETE WILSON, Governor

DEPARTMENT OF TOXIC SUBSTANCES CONTROL
400 P Street, 4th Floor
P.O. Box 806
Sacramento, CA 95812-0806

(916) 322-3670

Commanding Officer
Naval Station Treasure Island
Attention: Jim Sullivan, Code 80
Naval Base
San Francisco, California 94130

Dear Mr. Sullivan:

USE OF SPENT SANDBLAST GRIT IN THE MANUFACTURE OF ASPHALT CONCRETE/DEMONSTRATION VARIANCE - HUNTERS POINT ANNEX

A work plan for a Field Demonstration of Asphalt Treatment Technology for Spent Sandblasting Grit, July 9, 1991, along with supporting documentation, The Chemical Stabilization of Metal-Contaminated Sandblasting Grit at Naval Station, Treasure Island, Hunters Point Annex, January 25, 1991, was submitted to the Alternative Technology Division of the Department of Toxic Substances Control (DTSC). The work plan proposes the recycling of approximately 3,200 cubic yards of spent sandblasting grit at Hunters Point Annex into asphalt concrete. About 800 cubic yards of this grit have already been treated using a sodium hydrosulfide chemical stabilization procedure. The applicant proposes to conduct a pilot scale study incorporating about 5 cubic yards of the treated sandblasting grit and 5 cubic yards of the untreated sandblasting grit into asphalt concrete before conducting full scale recycling. In this letter, the DTSC will address only the pilot study as a demonstration project, in consideration of a research, development and demonstration variance from hazardous waste treatment permitting requirements.

The following information was provided in the work plan for a Field Demonstration of Asphalt Treatment Technology for Spent Sandblasting Grit, July 9, 1991, including information incorporated by reference to The Chemical Stabilization of Metal Contaminated Sandblasting Grit, January 25, 1991, and in subsequent amendments to the workplan submitted as "Response to DTSC Comments on the Draft Work Plan" on November 1, 1991:

1. Approximately 5 cubic yards of untreated spent sandblasting grit and 5 cubic yards of sulfide treated spent sandblasting grit from Hunters Point Annex will be incorporated into an asphalt concrete product, which will subsequently be laid on roadways at Hunters Point Annex.

2. The spent sandblasting grit was tested for total and soluble metals using the California Waste Extraction Test, for the U.S. EPA's toxicity characteristic metals using the federal

STATE OF CALIFORNIA—ENVIRONMENTAL PROTECTION AGENCY

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The following information was provided in the work plan for a Field Demonstration of Asphalt Treatment Technology for Spent Sandblasting Grit, July 9, 1991, including information incorporated by reference to The Chemical Stabilization of Metal Contaminated Sandblasting Grit, January 25, 1991, and in subsequent amendments to the workplan submitted as "Response to DTSC Comments on the Draft Work Plan" on November 1, 1991:

1. Approximately 5 cubic yards of untreated spent sandblasting grit and 5 cubic yards of sulfide treated spent sandblasting grit from Hunters Point Annex will be incorporated into an asphalt concrete product, which will subsequently be laid on roadways at Hunters Point Annex.

2. The spent sandblasting grit was tested for total and soluble metals using the California Waste Extraction Test, for the U.S. EPA's toxicity characteristic metals using the federal

Toxicity Characteristic Leaching Procedure, and for mono-butyl, di-butyl, and tri-butyl tin chlorides. No metal analyses exceeded the federal toxicity characteristic regulatory thresholds or California's Total Threshold Limit Concentrations. However, soluble concentrations of lead and copper exceeded California's Soluble Threshold Limit Concentrations for those metals. Taking into account both the treated and untreated sandblasting grit, lead averaged 12.8 mg/L and copper averaged 140 mg/L. The organic tin compounds averaged 22.4 ppm for the mono-butyl tin chloride compound, 15.0 ppm for the di-butyl tin chloride compound, and 70.7 ppm for the tri-butyl tin chloride compound.

The sandblasting grit was also tested for organic priority pollutants, including semivolatile organic compounds, volatile organic compounds, pesticides and PCB's. The priority pollutant testing was inconclusive due to possible laboratory contamination of test samples and will be done again during the pilot study.

3. The spent sandblasting grit will be transported from Hunters Point Annex, Treasure Island Naval Station, to Reed & Graham asphalt manufacturer in San Jose, in covered trucks.

4. The spent sandblasting grit will be stored at the Reed & Graham plant on a concrete pad surrounded by three walls and a berm on the side with no wall for no more than two weeks. The grit will be covered when not being used, to prevent wind dispersal.

5. The grit will be mixed into the asphalt as approximately 7% of the asphalt-aggregate mixture.

6. Bench scale testing of a "7% mix" indicated that the soluble concentration of lead in the asphalt concrete product was less than 0.05 mg/L, while the soluble concentration of copper was 4.4 mg/L.

7. Six test strips of asphalt concrete will be laid on roadways at Hunters Point Annex. These roadways will receive the normal load of Annex traffic, which however may be considered a "light load" when compared to state freeways or busy city streets. Each strip will be 40 to 50 feet long. Two strips will be made of asphalt concrete using the untreated sandblasting grit, two strips will be made from the treated sandblasting grit, and two strips will be made with normal asphalt concrete aggregate, as a control.

The test strips will be tested for physical properties to ensure appropriate Caltrans specifications are met, and for chemical parameters to determine leaching of heavy metals. This testing will be done as soon as the asphalt has cooled, approximately three days after application. Similar testing of the asphalt concrete strips will also be done six months after application. Furthermore, six months after the asphalt concrete strips are laid, sections of the test strips will be broken up using road cutting equipment to assess exposure to hazardous constituents in air borne particulates. Air monitoring will be performed for total particulates and metals.

8. The demonstration project (removal of the sandblasting grit, transport to Reed & Graham, incorporation into asphalt, and return of the asphalt concrete to Hunters Point Annex for laying on roadways) will not exceed two months.

9. The health and safety plan in the work plan included the following components: key personnel and responsibilities; potential health and safety hazards, anticipated weather conditions, a risk assessment summary, personal protective equipment, work practices, decontamination procedures, and an emergency plan. A calculated exposure assessment for heavy metals based on an assumed maximum of 5 $mg/m^3$ of total dust indicated that exposure levels to the metals were well below the [OSHA] PEL / [ACGIH] TLV concentrations. (Although this calculation was not done for the organic tin compounds, DTSC performed the calculation and found that the organic tins, too, would be well below the ACGIH TLV and STEL.) Also, the health and safety plan provided for hydrogen sulfide monitoring when the sulfide treated grit pile is first moved, in the event residual gases are still trapped in the pile. Work on the pile will stop if an action level of 5 ppm is exceeded.

Based on the authority granted to the DTSC in Section 25143, California Health and Safety Code (HSC), and in Section 66260.210, Title 22, California Code of Regulations (CCR), we find the proposed demonstration to be insignificant as a potential hazard to human health and safety and the environment because of the characteristics of the spent sandblast grit and the manner in which it is being handled and used. Therefore, the DTSC grants the Treasure Island Naval Station a variance from the hazardous waste facility permit requirements (Chapter 14, Division 4.5, Title 22, CCR) for the limited term pilot study described above, and from classifying as a hazardous waste (Chapter 11, Division 4.5, Title 22, CCR) the approximately

10 cubic yards of spent sandblasting grit used in the study, subject to the following conditions:

A. Continuous air monitoring for total particulates will be conducted at all times and all places the spent sandblasting grit is being handled (including loading and unloading from trucks and bins, sifting and sorting, etc.) to ensure particulate emissions do not exceed 5 $mg/m^3$. If particulate emissions exceed 5 $mg/m^3$, operations will cease immediately, and measures, such as wetting of the spent sandblasting grit, will be taken to reduce particulate emissions prior to proceeding with handling the grit. Furthermore, air monitoring for hydrogen sulfide gas from the treated spent blasting grit will be conducted both at Hunters Point Annex and at the asphalt manufacturing facility, Reed & Graham. Monitoring will be conducted to assess both worker exposure, as described in the workplan, and ambient concentrations of the hydrogen sulfide gas at Reed & Graham.

B. The three asphalt concrete strips designated for cutting shall also be ground up. Air monitoring, which shall be conducted for total particulates and metals [per Section 66261.24(a)(2)(A), CCR], shall be conducted to assess exposure both to the workers and to the public. The air monitoring protocol shall be approved by DTSC prior to the air monitoring.

C. Long term testing protocols and a schedule to be approved by the DTSC shall cover a period of three years after the test asphalt concrete strips are laid.

D. All other federal, state, or local statutes, regulations, ordinances, requirements, or limitations which are applicable to your project shall be followed.

E. This variance does not indicate compliance with any provision of Title 23 (Waters), CCR or provide a waiver to Title 23, CCR.

F. The DTSC contact for this project will be Ms. Jessie Schnell. The DTSC reserves the right to change the project contact by either telephone or written notice.

G. The DTSC reserves the right to have personnel present at any time during the demonstration, to take split samples, or to take photographs and/or video recording of the demonstration project.

H. The DTSC contact shall be notified at least three working days in advance of transfer of the spent sandblast grit from the Hunters Point Annex to the Reed & Graham plant for use in the manufacture of asphalt concrete.

I. The DTSC contact shall be notified within 24 hours by telephone and within 72 hours in writing of any emergencies or hazardous waste release occurring during, and related to the pilot study described in the Hunters Point work plan. Also, 24 hour notification is required if any changes in the proposed pilot study occur. These reporting requirements do not relieve the Department of the Navy of any other regulatory reporting requirements.

J. The demonstration project will be terminated at any time if the DTSC believes that the health or safety of the participants, the public, or the environment is endangered, or if the demonstration deviates significantly from the approved procedures.

K. The demonstration project shall comply with the Health and Safety Plan included in the work plan. A complete copy of the Health and Safety Plan shall be made available at the site to workers and visitors at any time during the pilot study.

L. The DTSC reserves the right to modify or revoke this variance at any time, pursuant to the provisions of Section 25143(d), HSC.

M. Reports on the demonstration project shall be submitted at each point in time that the asphalt concrete is tested (once it is laid and cooled, then again at six months, etc.). These reports shall include analytical results of the testing of the asphalt concrete product and of any air monitoring performed. The initial report, following testing of the freshly laid, cooled and set asphalt concrete, shall include a description of the project up to that point. The final report, submitted after the last test of the asphalt concrete, shall contain a summary of the entire project. All reports shall be submitted within three months of each testing of the asphalt concrete. Analytical tests of the asphalt concrete for lead and copper must be done by a certified hazardous waste laboratory, in accordance with procedures contained in the U.S. EPA's Test Methods for Evaluating Solid Waste, SW846. Tests of the physical properties of the asphalt concrete must be evaluated by an authorized CALTRANS representative or a qualified transportation laboratory to indicate if applicable CALTRANS specifications have been met. Reports are to be submitted to the DTSC contact for this project.

N. This variance shall apply only to materials and methods described in the pilot study proposal in the July 1991 Hunters Point work plan and November 1, 1991 amendments. The protocol for this study, as described in the same work plan and amendments, shall be followed.

O. This variance expires three months from the date of issue.

P. The onsite storage of any hazardous waste generated by the demonstration activities or remaining onsite following the demonstration shall comply with the federal facility agreement for Hunters Point Annex, including applicable environmental requirements, entered into by the Department of the Navy, the California Department of Toxic Substances Control (formerly with the Department of Health Services), and the San Francisco Bay Regional Water Quality Control Board, of September 30, 1990, as amended in 1991.

If you have any questions, please contact Ms. Jessie Schnell of my staff at (916) 322-1003.

Sincerely,

James T. Allen, Ph.D., Chief
Alternative Technology Division

cc: Mr. Michael A. Miguel
Department of the Navy
Naval Facilities Engineering Command
P.O. Box 727
San Bruno, California 94066-0720

Mr. Jeffery C. Heath, Code L71
Naval Civil Engineering Laboratory
Environmental Protection Division
Port Hueneme, California 93043-5003

Mr. Howard Hatayama
Regional Administrator
Region 2/Berkeley
Department of Toxic Substances Control
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Mr. Bill Brown
Region 2/Berkeley
Site Mitigation Branch
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Mr. Scott Lutz
Bay Area Air Quality Management District
939 Ellis Street
San Francisco, California 94109

Mr. Steve Ritchie
San Francisco Bay Regional Water Quality Control Board
1111 Jackson Street
Oakland, California 94607

Ms. Roberta Blank
U.S. Environmental Protection Agency
Region 9
75 Hawthorne Street
San Francisco, California 94105

Mr. Bruce La Belle
Alternative Technology Division
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

Mr. John Wesnousky
Alternative Technology Division
Department of Toxic Substances Control
P.O. Box 806
Sacramento, California 95812-0806

JTA:JS:js/ba

## APPENDIX H

## BAY AREA AIR QUALITY MANAGEMENT DISTRICT
## EXPERIMENTAL EXEMPTION
## FOR THE PILOT-SCALE TEST

# BAY AREA AIR QUALITY MANAGEMENT DISTRICT



November 22, 1991

Jeff Solari
**R&G Environmental Services, Inc.**
1540 Parkmoor Ave., Suite A
San Jose, CA 95128-4206
P.O. Box 5940
San Jose, CA 95150

Dear Mr. Solari:

This is in response to your letter of November 15, 1991 requesting an Experimental Exemption pursuant to Regulation 1, Section 111 to conduct testing on a Sandblast Grit/Asphalt Pilot Project.

This letter is our approval to conduct such testing which is subject to the following conditions:

- The test period will be from November 23, 1991 through November 30, 1991.
- Prior written approval shall be obtained from the local health officer.
- Testing will be terminated immediately upon the declaration of an air pollution episode/alert.
- All operations covered by this exemption will be terminated immediately should the District, at any time, determine the emissions cause a public nuisance.
- This exemption applies to emissions of soluble lead and copper.
- The emissions from the testing do not interfere with the attainment or maintenance of any California or Federal ambient air quality standard.
- Product is to be covered during transportation.
- The District will be provided a full report of the test results upon completion of the project.

- That a fee of $1,680.00, as required by Regulation 3, Section 313, be received by the District. The check should be made payable to the Bay Area Air Quality Management District and should reference Invoice #27834.

If you have any questions regarding this matter, please contact Ray Peterson, Enforcement Specialist, at (415) 749-4797.

Very truly yours,

Milton Feldstein
Air Pollution Control Officer

*RP:rg*

cc: Mr. Edwin Kohler
Deputy Director
Office of Toxics Enforcement
County Health Department
2220 Moorpark
San Jose, CA 95128

bc: Chron, Source File, Inspector, Peterson, Feldstein, Marotto, Nicolas.

# APPENDIX I

## ASPHALT FIELD MEASUREMENT REPORT FOR THE PILOT-SCALE TEST

FIELD NOTES - NOVEMBER 23, 1991
0900H - 1630H
HUNTERS POINT ANNEX
<u>US NAVY - SAND RECYCLE PROJECT</u>

1. 0800 CREWS ON SITE
0800 - 0830 REMOVED ALL VEGETATION FROM TEST AREAS - BROOM FREE OF ALL SOIL, DUST AND CONTAMINATION.

SUBGRADE PAVEMENT SURFACE
55°F - 57°F
APPLY TACT COAT, SS-1H EMULSION
0.10 GAL/YD$^2$ - UNIFORM APPLICATION

2. SET TRAFFIC CONTROL - NOTIFIED BASE SECURITY AND FIRS DEPT.

3. RECEIVED 1ST LOAD - 1020H -
TEMPERATURE UNDER TARP - 303°F
2nd load 1030H - 315°F

4. TEST SECTION I (CONTROL MIX)
TEMP OF SECTIONS DURING INITIAL LAY ______

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| 247°F | 250°F | 255°F | 260°F | 260°F | 255°F |

5. ESTABLISHED ROLLER PATTERN WITH NUCLEAR DENSITY ________
3 LONGITUDINAL PASSES - OVERLAY
2 TRANSVERSE PASSES - OVERLAY

6. TEST PATTERN
TEST SECTION - 1 CONTROL

3 PASSES

| | |
|---|---|
| 143.2 | 144.2 |
| 143.2 | 141.8 |
| 144.1 | 143.6 |

5 PASSES FINAL ROLLING
DENSITY - 1 LB/CUBIC FT.

| | | |
|---|---|---|
| 144.9 | 146.9 | |
| 146.8 | 147.3 | <u>146.6</u> LBS/CU. FT. |
| 147.5 | 146.8 | 153.0 MAX <u>DENSITY</u> 95% |

95% COMPACTION

TEST <u>SECTION</u> 2 - UNTREATED SAND
DENSITY - 1 LB/CU.FT.

| | | |
|---|---|---|
| 146.1 | 146.4 | TEMPERATURE 260°F - 270°F |
| 144.1 | 147.8 | 95-96% COMPACTION |
| 147.6 | 149.0 | |

TEST SECTION 3 - TREATED SAND
TEMP 260°F - 270°F

| | | |
|---|---|---|
| 148.1 | 146.4 | |
| 157.4 | 148.1 | 147.5 LBS/CU. FT. |
| 146.9 | 149.1 | 96% COMPACTION |
| 148.1 | 146.7 | |

SAMPLES WERE OBTAINED FROM EACH MIX FOR DENSITY DETERMINATION (IF REQUIRED) BASED ON MAXIMUM THEORETICAL DENSITY - RICE GRAVITY METHOD

12:30 _____ LOADS - TREATED SANDS
303°F TEMP IN TRUCK UPON ARRIVAL

2:30H - 1430H - FINAL LOADS
TREATED SAND -
FOG SEAL APPLIED - 3:45 - 1543 HOURS
NOTIFIED BASK SECURITY - AREA OPEN FOR TRAFFIC 1610H
4:10PM SECURE OPERATIONS

OBSERVATIONS:

1) APPEARANCE OF MIX - GOOD TEXTURE. NO EVIDENCE OF ROLLER CHECKING TEARS OR SEPARATIONS - ALL SECTIONS UNIFORM - GOOD JOINT CLOSURES CLOSED SURFACE.

2) COMPACTION 96-98%

3) SAMPLES OBTAINED FROM EACH TEST AREA - FURTHER TESTING IF REQUIRED.

4) UNIFORM FOG COAT

KEN BEEDE
CIVIL ENGINEER

:FILDNOTE\wp\mn

# APPENDIX J

# CONTACTS MADE TO IDENTIFY A COMPANY FOR THE FULL-SCALE TEST OF SANDBLASTING GRIT RECYCLING

## TABLE J-1. LIST OF COMPANIES CONTACTED[a]

| Company | Location | Type | Phone | Contact Name |
|---|---|---|---|---|
| Dun Barton Quarry | Fremont | plant | 510-793-8861 | Clay Buckley |
| Syar Industries | Napa | plant | 707-252-8711 | Don McConnell |
| Granite Rock Co. | SF plant 415-396-0091 | plant | 408-724-5611 main | Sanjar Chakamian |
| American Rock & Asphalt | Oakland area | plant | 510-233-8362 | John Williams |
| Street & Sewer Dept. | SF County | plant | 415-695-2101 | Richard Cunningham |
| George Reed Asphalt Co. | 100 mi away | plant | 209-334-0790 | Bruce Beattie |
| Kaiser Sand & Gravel | plant too far | dist. | 510-945-0505 | did not give name |
| Raisch Products | San Jose/Santa Clara | plant | 408-227-9222 | did not give name |
| Mission Valley Asph. Co. | Oakland area | plant | 510-862-2277 | Mort Tolliver |
| RMC Lonestar | Oakland area | plant | 510-689-8900 | |
| Harbor Sand & Gravel | too far | plant | 916-442-9089 | |
| Mark West Quarry | too far | plant | 707-573-9733 | |
| Chevron USA Inc. | SF area | dist | 415-784-5115 | David Larkins |
| Industrial Asphalt | SF area | | 415-846-5125 | |
| Olive Springs Quarry Inc. | Soquel | plant | 408-475-1868 | Jerry Harn |
| Reed & Graham, Inc. | San Jose area | pave | 408-287-1400 | |
| Antioch Bldg. Mtls | SF area | dist | 415-432-3828 | |
| Berkeley Ready Mix Co. | Berkeley | dist | 415-526-1611 | |
| Bode Gravel Co. | SF area | pave | 415-861-5321 | Stan Cody |
| Ford Gravel Co. | Ukiah (120 mi north) | plant | 707-462-5251 | |
| Millbrae Mtls. Co. | SF area | dist | 415-697-1736 | |
| Shamrock Mtls Inc. | SF area | dist | 415-454-9055 | |
| Amer. Asphalt Repair | SF area | pave | 415-366-0144 | |
| Esquivel Grad. & Paving | SF area | pave | 415-822-5400 | |
| McGuire & Hester | Oakland area | pave | 510-632-7676 | |
| Berkeley Asphalt Co. | Berkeley | plant | 510-526-1611 | |
| Pacific Supply | San Jose area | dist | 510-659-9701 | |

[a]This list includes only those companies where there was contact with an individual. There were approximately 15 companies where the number was incorrect or the company had gone out of business.

**APPENDIX K**

**EXAMPLE TRANSPORTATION PLAN**

## 7.0 TRANSPORTATION PLAN

This chapter discusses the plans for complying with transportation requirements of moving the grit on highways in California. Several of the requirements are as follows and discussed in the following sections:

- Each vehicle will have a tarp that is placed over the exposed portion of the grit.
- The grit will be unloaded at ARA directly into the lined storage areas.
- The drivers and hot plant employees will have initial tailgate safety meetings to discuss this project.

### 7.1 DRIVER TRAINING

All truck drivers will be trained and educated on the material they are handling. The drivers will meet and be provided with a packet of documents that will include the following documents.

- A map with clearly defined instructions on the route of travel
- Material Safety Data Sheets, if available, for copper and lead
- Laboratory result data sheets, if available, for analyses performed on material being carried.

### 7.2 STORAGE AT R&G

Upon arrival at the hot plant facility, the grit will be offloaded at the designated storage location. The grit storage area will be clearly marked and segregated from other aggregate materials at the plant.

## 7.3 DECONTAMINATION OF THE TRUCKS

Equipment that comes directly in contact with the grit will be decontaminated with water or wet towels. The washwater will be collected in a drum and chemically analyzed for TTLC metals and, if necessary based on the TTLC data, STLC Cu and Pb to ensure that it is nonhazardous and then dispositioned accordingly.

# APPENDIX L

# EXAMPLE WASTE PROFILE FOR DEBRIS SEPARATED FROM THE SPENT SANDBLASTING GRIT

Date Printed 03/14/90 X Chemical Waste Management, Inc. CWL AE0555

WASTE PROFILE Profile #

( ) Check here if this is a Recertification LOCATION OF ORIGINAL KETTLEMAN HILLS FACILITY

GENERAL INFORMATION

1. Generator Name: NAVAL STATON T I Generator USEPA ID: CA6170090421

2. Generator Address: HUNTERS POINT ANNEX Billing Address: BATTELLE MEMORIAL INSTITUTE
(_) Same
505 KING AVE

SAN FRANCISCO CA 94130

3. Technical Contact/Phone: JEFFERY MEANS 614/424-6442 COLUMBUS OH 43201

4. Alternate Contact/Phone: GREG HEADINGTON 614/424-5417 Billing Contact/Phone: JEFFERY MEANS 614/424-5442

PROPERTIES AND COMPOSITION

5. Process Generating Waste: SHIPYARD SANDBLASTING OPERATION / ENVIRONMENTAL TECHNOLOGY DEMONSTRATION

6. Waste Name: DEBRIS - METALS, RAGS, WOOD. W/LEAD, COPPER, R.R. TIES

7A. Is this a USEPA hazardous waste (40 CFR Part 261)? Yes (_) No (X)
B. Identify ALL USEPA listed and characteristic waste code numbers (D,F,K,P,U): ______ State Waste Codes: 181

8. Physical State @ 70F: A. Solid(X) Liquid(_) Both(_) Gas(_) B. Single Layer (X) Multilayer (_) C. Free liq. range 0 to 0%

9A. pH: Range ______ or Not applicable (X) B. Strong Odor (_);describe ______

10. Liquid Flash Point: < 73F (_) 73-99F (_) 100-139F (_) 140-199F (_) >= 200F (_) N.A. (X) Closed Cup (X) Open Cup (_)

11. CHEMICAL COMPOSITION: List ALL constituents (incl. halogenated organics) present in any concentration and forward analysis

| Constituents | Range | Unit Description |
|---|---|---|
| METAL DEBRIS | 30 to 50 | % |
| CLOTH / PLASTIC | 15 to 20 | % |
| WOOD DEBRIS | 30 to 50 | % |
| COPPER | 150 to 4700 | MG/KG |
| LEAD (TCLP < 5 PPM) | 53 to 1100 | MG/KG |
| | to | |
| TOTAL COMPOSITION (MUST EQUAL OR EXCEED 100%): | 120.000000 | |

12. OTHER: PCBs if yes, concentration _ ______ ppm, PCBs regulated by 40 CFR 761 (_). Pyrophoric (_) Explosive (_) Radioactive (_) Benzene if yes, concentration _ ______ ppm. NESHAP (_) Shock Sensitive (_) Oxidizer (_) Carcinogen (_) Infectious (_) Other ______

13. If waste subject to the land ban & meets treatment standards, check here: _ & supply analytical results where applicable.

SHIPPING INFORMATION

14. PACKAGING: Bulk Solid (X) Bulk Liquid (_) Drum (_) Type/Size: BULK Other ______

15. ANTICIPATED ANNUAL VOLUME: 50 Units: TONS Shipping Frequency: WEEK

SAMPLING INFORMATION Sample Tracking Number: 4827574

16a. Sample source (drum, lagoon, pond, tank, vat, etc.): ______

Date Sampled: ______ Sampler's Name/Company: ______

16b. Generator's Agent Supervising Sampling: ______ 17. (X) No sample required (See instructions.)

GENERATOR'S CERTIFICATION

I hereby certify that all information submitted in this and all attached documents contains true and accurate descriptions of this waste. Any sample submitted is representative as defined in 40 CFR 261 - Appendix I or by using an equivalent method. All relevant information regarding known or suspected hazards in the possession of the generator has been disclosed. I authorize CWM to obtain a sample from any waste shipment for purposes of recertification.

[signature] SIGNATURE NOT ON FILE James B. Sullivan 6/8/94

Signature Name and Title Date

Environmental Coordinator

Date Printed 03/14/94

CWL AE0555

Profile #

18. This is a Nonwastewater.

19. If this waste is subject to any California list restrictions enter the letter from below (either A, B.1 or B.2) next to each restriction that is applicable:

___ HOCs, ___ PCBs, ___ Acid, ___ Metals, ___ Cyanides

20. Identify ALL Characteristic and Listed USEPA hazardous waste numbers that apply (as defined by 40 CFR 261). For each waste number, identify the subcategory (as applicable, check none, or write in the description from 40 CFR 268.41, 268.42, and 268.43).

| REF # | A. US EPA HAZARDOUS WASTE CODE(S) | B. SUBCATEGORY Enter the subcategory description. If not applicable, simply check none | | C. APPLICABLE TREATMENT STANDARDS PERFORMANCE-BASED: Check as applicable | | SPECIFIED TECHNOLOGY: If applicable enter the 40 CFR 268.42 table 1 treatment code(s) | D. HOW MUST THE WASTE BE MANAGED? Enter letter from below |
|---|---|---|---|---|---|---|---|
| | | DESCRIPTION | NONE | 268.41(a) | 268.43(a) | 268.42 | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

Management under the land disposal restrictions:

A. RESTRICTED WASTE REQUIRES TREATMENT

B.1 RESTRICTED WASTE TREATED TO PERFORMANCE STANDARDS

B.2 RESTRICTED WASTES FOR WHICH THE TREATMENT STANDARD IS EXPRESSED AS A SPECIFIED TECHNOLOGY (AND THE WASTE HAS BEEN TREATED BY THAT TECHNOLOGY)

B.3 GOOD FAITH ANALYTICAL CERTIFICATION FOR INCINERATED ORGANICS

C. RESTRICTED WASTE SUBJECT TO A VARIANCE

D. RESTRICTED WASTE CAN BE LAND DISPOSED WITHOUT FURTHER TREATMENT

E. NOT CURRENTLY SUBJECT TO LAND DISPOSAL RESTRICTIONS

21. Is this waste a soil and/or debris? No: _ Yes, Soil: _ Yes, Debris: X Yes, Both: _

22. Specific Gravity Range: _____ to _____

23. Indicate the range of each: Units

Cyanides: _ None ________ to ____________ _______ Type (free, total, amenable, etc.) ____________

Cyanides: _ None ________ to ____________ _______ Type (free, total, amenable, etc.) ____________

Sulfides: _ None ________ to ____________ _______ Type ____________

Optional Phenolics: _ None ________ to ____________ _______

24. Identify the waste color VARIES, DOT physical state Solid,

and physical appearance SOLID

Date Printed 03/14/94

CWL AE0555

Profile #

| 25. COMPLETE ONLY FOR WASTES INTENDED FOR FUELS OR INCINERATION | 26. RECLAMATION, FUELS or INCINERATION PARAMETERS (Provide if information is available) |
|---|---|
| TOTAL | RANGE |
| Beryllium as Be ____ ppm | A. Heat Value (Btu/lb): ____-____ |
| Potassium as K ____ ppm | B. Water: ____ |
| Sodium as Na ____ ppm | C. Viscosity (cps): ____@____F _ 100 F _ 150 F |
| Bromine as Br ____ % | D. Ash: ____ % |
| Chlorine as Cl ____ % | E. Settleable solids: ____ % |
| Fluorine as F ____ % | F. Vapor Pressure @ STP (mm/Hg): ____ |
| Sulfur as S ____ % | G. Is this waste a pumpable liquid? Yes _ No _ |
| | H. Can this waste be heated to improve flow? Yes _ No _ |
| | I. Is this waste soluble in water? Yes _ No _ |
| | J. Particle size: Will the solid portion of this waste pass through a 1/8 inch screen? Yes _ No _ |

27. TRANSPORTATION INFORMATION

A. Is this a DOT Hazardous Material? Yes _ No X

B. Proper Shipping Name. . . . . . . . . .: NON-RCRA HAZARDOUS WASTE, SOLID

and Additional Description if required: (DEBRIS, WOOD)

C. DOT Regulations: ____ Hazard Class: 00 Non-Regulated Mat. I.D. ____ Packing Group: ___

D. CERCLA Reportable Quantity (RQ) and units (Lb, Kg): ____

E. Non-Bulk code ___ Bulk code ___

F. Special Provisions ___ ___ ___ ___ ___ ___

G. Labels Required ____ ____ ____

28. SPECIAL HANDLING INFORMATION

_ Material Safety Data Sheets Attached

29. OTHER INFORMATION

RECEIVED 10/25/93.

30. CHEMICAL WASTE MANAGEMENT CERTIFICATION

Chemical Waste Management, Inc. has all the necessary permits and licenses for the waste that has been characterized and identified by this approved profile.

Date Printed 03/14/94

CWL AE0555

Profile #

31. OTHER HAZARDOUS CONSTITUENTS Indicate if the waste contains any of the following.

| METALS | TCLP Information: Check only ONE for each constituent Use units: ppm, mg/l | | | | TCLP Data | TCA or TOTAL Use units: ppm, mg/l, mg/kg or percent | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Less Than | TC Regulated Level | Equal or More | Waste No. | TCLP Actual | California List Less Than | Regulated Level | Equal or More | Actual |
| Arsenic as As | X | 5.0 mg/l | | D004 | | | 500 mg/l | | |
| Barium as Ba | X | 100.0 mg/l | | D005 | | | | | |
| Cadmium as Cd | X | 1.0 mg/l | | D006 | | | 100 mg/l | | |
| Chromium tot Cr | X | 5.0 mg/l | | D007 | | | | | |
| Lead as Pb | X | 5.0 mg/l | | D008 | | | 500 mg/l | | |
| Mercury as Hg | X | .2 mg/l | | D009 | | | 20 mg/l | | |
| Selenium as Se | X | 1.0 mg/l | | D010 | | | 100 mg/l | | |
| Silver as Ag | X | 5.0 mg/l | | D011 | | | | | |
| Nickel as Ni | | | | | | | 134 mg/l | | |
| Thallium as Tl | | | | | | | 130 mg/l | | |
| Chromium Hex | | | | | | | 500 mg/l | | |
| Antimony | | | | | | | | | |
| Beryllium | | | | | | | | | |
| Copper | | | | | | | | | |
| Vanadium | | | | | | | | | |
| Zinc | | | | | | | | | |
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Date Printed 03/14/94

CWL AE0555

Profile #

32. OTHER HAZARDOUS CONSTITUENTS Indicate if the waste contains any of the following.

| ORGANICS | TCLP Information: Check only ONE for each constituent | | | | TCLP Data | TCA or TOTAL Use units: ppm, mg/l or % |
|---|---|---|---|---|---|---|
| | Less Than | Regulated Level | Equal or More | Waste No. | TCLP Analytical Test Results Use units: ppm or mg/l | |
| Benzene | X | 0.5 mg/l | | D018 | | |
| Carbon Tetrachloride | X | 0.5 mg/l | | D019 | | |
| Chlordane | X | 0.03 mg/l | | D020 | | |
| Chlorobenzene | X | 100.0 mg/l | | D021 | | |
| Chloroform | X | 6.0 mg/l | | D022 | | |
| m-Cresol | X | 200 mg/l | | D024 | | |
| o-Cresol | X | 200.0 mg/l | | D023 | | |
| p-Cresol | X | 200.0 mg/l | | D025 | | |
| Cresol | X | 200.0 mg/l | | D026 | | |
| 2,4-D | X | 10.0 mg/l | | D016 | | |
| 1,4 Dichlorobenzene | X | 7.5 mg/l | | D027 | | |
| 1,2-Dichloroethylene | X | 0.5 mg/l | | D028 | | |
| 1,1-Dichloroethylene | X | 0.7 mg/l | | D029 | | |
| 2,4-Dinitrotoluene | X | 0.13 mg/l | | D030 | | |
| Endrin | X | .02 mg/l | | D012 | | |
| Heptachlor, & Hydroxide | X | 0.008 mg/l | | D031 | | |
| Hexachloro-1,3 Butadiene | X | 0.5 mg/l | | D033 | | |
| Hexachlorobenzene | X | 0.13 mg/l | | D032 | | |
| Hexachloroethane | X | 3.0 mg/l | | D034 | | |
| Lindane | X | 0.4 mg/l | | D013 | | |
| Methoxychlor | X | 10.0 mg/l | | D014 | | |
| Methyl Ethyl Ketone | X | 200.0 mg/l | | D035 | | |
| Nitrobenzene | X | 2.0 mg/l | | D036 | | |
| Pentachlorophenol | X | 100.0 mg/l | | D037 | | |
| Pyridine | X | 5.0 mg/l | | D038 | | |
| Tetrachloroethylene | X | 0.7 mg/l | | D039 | | |
| Toxaphene | X | 0.5 mg/l | | D015 | | |
| 2,4,5-TP Silvex | X | 1.0 mg/l | | D017 | | |
| Trichloroethylene | X | 0.5 mg/l | | D040 | | |
| 2,4,5-Trichlorophenol | X | 400.0 mg/l | | D041 | | |
| 2,4,6-Trichlorophenol | X | 2.0 mg/l | | D042 | | |
| Vinyl Chloride | X | 0.2 mg/l | | D043 | | |
| | | | | | | |
| | | | | | | |

# CALIFORNIA LAND DISPOSAL RESTRICTION NOTICE AND CERTIFICATION

| | |
|---|---|
| Generator Name Naval Station Treasure Island | Manifest Number |
| California Hazardous Waste Code(s) | CWM Profile Number |

This form is submitted to Chemical Waste Management, Inc. in accordance with the requirements of CCR Title 22, Chapter 18, Article 1, which restricts the land disposal of certain hazardous wastes. I have marked the appropriate box (boxes A through D) below to indicate how my waste must be managed to conform to the land disposal restrictions. A copy of all applicable treatment standards and waste analysis data, where available, is maintained at the Chemical Waste Management facility identified on the manifest referenced above. I have entered the appropriate California Waste Code and checked the appropriate box in the table below to indicate the applicable non-RCRA hazardous waste listing from 22 CCR § 66268.29.

| ✓ | State of California Restricted Waste Description Listed in 22 CCR § 66268.29 | Prohibition Implementation Date | Corresponding Treatment Standard (from 22 CCR) |
|---|---|---|---|
| | 1 Metal-containing aqueous waste identified in 22 CCR 66268.29(a). | 1/26/90 | 66268.107(a) |
| | 2 PCB wastes identified in section 66268.29(b). | 1/27/90 | 66268.110 |
| | 3 Auto shredder waste identified in section 66268.29(c). | 5/8/91 | 66268.106(a)(1) |
| | 4 Non-wastewater solvent waste identified in section 66268.29(d). | 5/8/91 | 66268.107(b) |
| | 5 Hazardous waste foundry sand identified in section 66268.29(e). | 1/1/91 | 66268.106(a)(2) |
| | 6 (reserved) (for oily petroleum wastes) | | |
| | 7 Metal-containing solid waste identified in section 66268.29(g). | 1/1/95 | 66268.106(a)(3) |
| | 8 Fly ash, bottom ash, retort ash or baghouse waste identified in 66268.29(h). | 1/1/91 | 66268.106(a)(4) |
| | 9 Baghouse waste from foundries identified in section 66268.29(i). | 1/1/91 | 66268.106(a)(5) |
| | 10 Aqueous and liquid organic waste identified in section 66268.29(j). | 1/1/95 | 66268.112 |
| | 11 Solid waste containing organics identified in section 66268.29(k). | 1/1/95 | 66268.113 |
| | 12 (reserved) (for liquid redox with metals) | | |
| | 13 Asbestos-containing waste identified in section 66268.29(m). | 3/1/93 | 66268.114 |

☐ **A. RESTRICTED WASTE REQUIRES TREATMENT**
**I am the generator of the waste identified above which must be treated to meet the applicable treatment standards set forth in CCR Title 22, article 4 or article 11 of Chapter 18.**

☐ **B.1 RESTRICTED WASTE TREATED TO PERFORMANCE STANDARDS**
*"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based upon my inquiry of those individuals immediately responsible for obtaining this information, I believe that the treatment process has been operated and maintained properly so as to comply with the performance levels specified in article 4 and article 11 of chapter 18, division 4.5, Title 22, CCR and all applicable prohibitions set forth in section 66268.32 or RCRA section 3004(d) (42 U.S.C. section 6924(d)) without impermissible dilution of the prohibited waste. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment."*

**C. RESTRICTED WASTE SUBJECT TO AN EXEMPTION [22 CCR 66268.7(a)(3)]**
The waste identified above is subject to a prohibition implementation date of __________.

**D. RESTRICTED WASTE CAN BE LAND DISPOSED WITHOUT TREATMENT**
*"I certify under penalty of law that I personally have examined and am familiar with the waste through analysis and testing or through knowledge of the waste to support this certification, that the waste complies with the treatment standards specified in CCR Title 22, division 4.5, chapter 18, article 4 and article 11 and all applicable prohibitions set forth in CCR Title 22, section 66268.32 or RCRA section 3004(d)(42 U.S.C. section 6924(d)). I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment."*

I hereby certify that all information submitted in this and all associated documents is complete and accurate to the best of my knowledge and information.

| | | |
|---|---|---|
| Signature: [signature] | Title: Environmental Coordinator | Date: 6/2/94 |

# CALIFORNIA LAND DISPOSAL RESTRICTION NOTICE AND CERTIFICATION FORM - REVERSE SIDE
## CALIFORNIA LIST TREATMENT STANDARDS

...the w... identifie... in the other side of this form is described by any of the following USEPA hazardous waste codes: F001, F002, F003, F004, F005 and/or ...s ...zardous waste ... subject to any prohibitions identified as California List restrictions then this page MUST accompany the shipment, along with the opposite ...f this form.

| CALIFORNIA LIST TREATMENT STANDARDS - 22 CCR 66268.32, 22 CCR 66268.42<br>A waste must first be designated as a hazardous waste before the waste can be subject to the California List restrictions. | | |
|---|---|---|
| **Restricted waste description** | **Prohibition** | **Treatment Standard** |
| ...id* or non-liquid wastes containing ...logenated Organic Compounds listed in 22 CCR 66268 Appendix III or III-A | Liquid* wastes: Greater than or equal to 1,000 mg/l<br>Non-liquid wastes: Greater than or equal to 1,000 mg/kg | 22 CCR 66268.42(a)(2) - INCIN |
| ...id* wastes containing PolyChlorinated ...iphenyls (PCBs) | Greater than or equal to 50 ppm | 22 CCR 66268.42(a)(1) - INCIN or FSUBS<br>Also see 40 CFR 761.60 and 40 CFR 761.70 |
| ...quid* wastes containing Cyanides | Free (amenable to chlorination) cyanides at concentrations greater than or equal to 1,000 mg/l | 22 CCR 66268.32(a) |
| ...iquid* wastes containing Metals | One or more of the following metals (or elements) at concentrations greater than or equal to the following:<br>Arsenic and/or compounds as As: 500 mg/l<br>Cadmium and/or compounds as Cd: 100 mg/l<br>Chromium and/or compounds as Cr: 500 mg/l<br>Lead and/or compounds as Pb: 500 mg/l<br>Mercury and/or compounds as Hg: 20 mg/l<br>Nickel and/or compounds as Ni: 134 mg/l<br>Selenium and/or compounds as Se: 100 mg/l<br>Thallium and/or compounds as Th: 130 mg/l | 22 CCR 66268.32(a) |
| ...d...d wastes | pH less than or equal to 2.0 | 22 CCR 66268.32(a) |

* the definition of "liquid" refer to Method 9095, the Paint Filter Liquids Test from USEPA Manual SW-846.

| SOLVENT TREATMENT STANDARDS FOR F001 THROUGH F005 WASTES | | | | | |
|---|---|---|---|---|---|
| CONSTITUENTS | TREATMENT STANDARDS* | | CONSTITUENTS | TREATMENT STANDARDS* | |
| | Wastewater | Non-Wastewater | | Wastewater | Non-Wastewater |
| [illegible] | 0.05 | 0.59 | Methylene chloride | 0.20 | 0.96 |
| ...* | 0.07 † | 3.7 †† | Methylene chloride from pharmaceutical production | 0.44 † | N/A |
| ...alcohol | 5.0 | 5.0 | Methyl ethyl ketone | 0.05 | 0.75 |
| ...disulfide | 1.05 | 4.81 | Methyl isobutyl ketone | 0.05 | 0.33 |
| ...n tetrachloride | 0.05 | 0.96 | Nitrobenzene | 0.66 | 0.125 |
| ...enzene | 0.15 | 0.05 | 2-Nitropropane | WETOX OR CHOXD; fb CARBN OR INCIN** | INCIN** |
| ... and cresylic acid | 2.82 | 0.75 | Pyridine | 1.12 | 0.33 |
| ...anone | 0.125 | 0.75 | Tetrachlorethylene | 0.079 | 0.05 |
| ...hlorobenzene | 0.65 | 0.125 | Toluene | 1.12 | 0.33 |
| ...ethanol | INCIN OR BIODG** | INCIN** | 1,1,1-Trichloroethane | 1.05 | 0.41 |
| ...tate | 0.05 | 0.75 | 1,1,2-Trichloroethane | 0.03 † | 7.6 †† |
| [illegible] | 0.05 | 0.053 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 1.05 | 0.96 |
| [illegible] | 0.05 | 0.75 | Trichloroethylene | 0.062 | 0.91 |
| ...nol | 5.0 | 5.0 | Trichlorofluoromethane | 0.05 | 0.96 |
| [illegible] | 0.25 | 0.75 | Xylene | 0.05 | 0.15 |

All treatment standards are expressed as mg/L constituent concentration in waste extract (Table CCWE 22 CCR § 66268.41), unless otherwise indicated [illegible]